Skyus-E™ IoT Appliance

User Manual

Installation, Configuration, and Management

User Manual

Preface

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Overview

The *Skyus-E IoT Appliance* simplifies the effort of implementing wireless connectivity in "Internet of Things" (IoT) networks. Built on FW's proven Skyus cellular modem technology, the Skyus-E provides a standard Ethernet interface for easy connection to customer devices.

The Skyus-E's rugged, compact aluminum body and its ease of installation make it perfect for deployment in a wide variety of IoT applications, including kiosks, digital signage, ATMs, and many others. Powered by FW's own Linux implementation, Axiom, the Skyus-E is capable of supporting nearly any FW Skyus module. With Axiom you get rapid connections, integrated connection management, and robust watchdog logic. Skyus-E features include:

- Operation on all major US carrier networks
- 4G LTE support on all major US carriers
- Modular design allows you to swap between Skyus carrier radio modules
- Skyus DS model allows you to switch carriers without switching hardware
- Standard Ethernet connection (LAN) to customer devices
- LED status indicators for power, activity, and signal strength
- GPS ready (Skyus DS models only)
- Skyus-E Administration Interface for system configuration and monitoring
- Integration with Crossroads IoT application framework
- Powered by the Axiom field data processing framework
- Future functionality and features in firmware updates

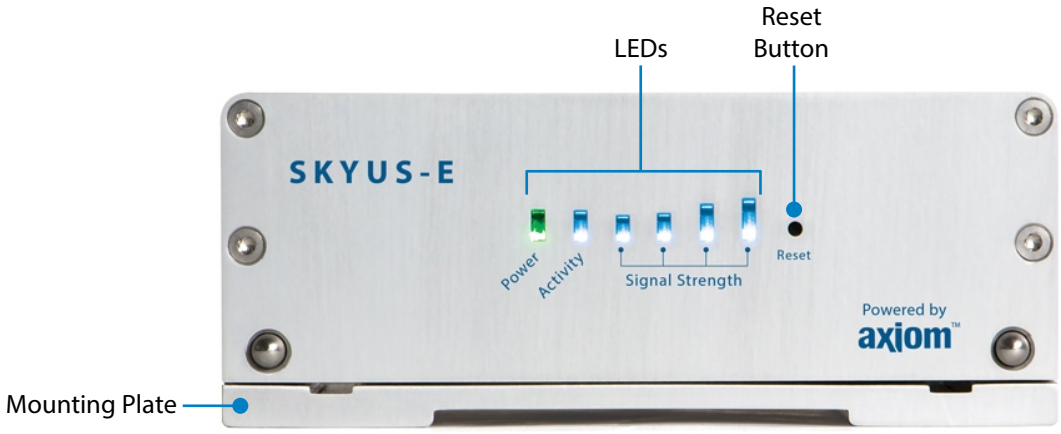

Figure 1: Skyus-E Front Panel

Intended Audience

This document is intended for users responsible for the configuration and management of the Skyus-E and assumes the user possesses a basic working knowledge of computer networking, wireless routing, and network administration.

Scope

This manual provides in-depth information about Skyus-E installation, configuration, and management. See the Skyus-E Quick Start Guide in the FW Literature Library for quick installation and configuration information.

Specifications

Hardware	
Input Voltage	• 9-36V DC, AC/DC adapter
Power Consumption	• Typical*: 12V @ 0.32A (3.84W) • Max: 12V @ 1.56A (18.75W) • Low Power: 8V @ 0.02A (0.16W) (* 3G module running Skyus-E Interface with Internet activity)
Environmental	• Operating Temperature: -20°C to 60°C (-4°F to 140°F) • Storage Temperature: -40°C to 85°C (-40°F to 185°F)
Construction	Rugged aluminum housing
Dimensions	5" (W) x 2" (H) x 5" (D) - Approximate, includes mounting plate
Weight	• Skyus-E: 0.554 kg (1.20 lbs) • Mounting Plate: 0.249 kg (0.55 lbs)
Mounting	Tool-free mounting of Skyus-E to mounting plate (sold separately)
Data Interface	One 10/100 Ethernet, RJ-45 (Ethernet switch recommended for expansion, if needed)
Antenna Connections	• Primary Cellular: 50 Ohm SMA (SubMiniature version A) female • MIMO if 4G LTE, Receive Diversity if 3G – 50 Ohm SMA female • GPS: 50 Ohm SMA female
LEDs	Power x1, Activity x1, Signal Strength x4. Signal LED color shows cellular connection type: Blue– 4G, Green–3G, Amber–2G, No lights–No Connection.
Upgrade Kit	Skyus-E upgrade kit for easy installation of existing Skyus modules.
Cellular	
Technologies	LTE with fallback to HSPA+, HSPA, UMTS, EDGE, GPRS, EVDO, 1xRTT (depending on the Skyus module used)
Carriers	Sprint, Verizon, AT&T, T-Mobile
Bands	See the Skyus Specification Sheet or the Skyus DS Specification Sheet for modem-specific information. (Skyus Global not supported.)
Multi-Carrier Support	Skyus 4G LTE embedded modem kit (Verizon, T-Mobile, AT&T) uses software-switchable radio technology for multi-carrier support.
Standards/Approvals	FCC Part 15, Class B
GPS (Skyus DS Models Only)	
Satellite Channels	16
Protocol	NMEA 0183 Version 3.0
Acquisition Time	• Hot Start: 1 second • Warm Start: 29 seconds • Cold Start: 32 seconds
Accuracy	• Horizontal: < 5m (90%) • Altitude: < 8m (90%) • Velocity: < 0.2 m/s

Sensitivity	• Tracking: –161 dBm • Acquisition (Assisted, non-LTE): –158 dBm • Acquisition (Assisted, LTE): –153 dBm • Acquisition (Standalone): –145 dBm
Operational Limits	• Altitude < 600m, or • Velocity < 100 m/s Either limit may be exceeded, but not both.
Software	
Operating System	AXIOM integrated connection management – FW embedded Linux image enables rapid addition of functions, features, and carrier support.
Security	Integrated onboard routing, Network Address Translation (NAT), and firewall module
Protocols	TCP/IP, UDP/IP, DHCP, HTTP

Block Diagram

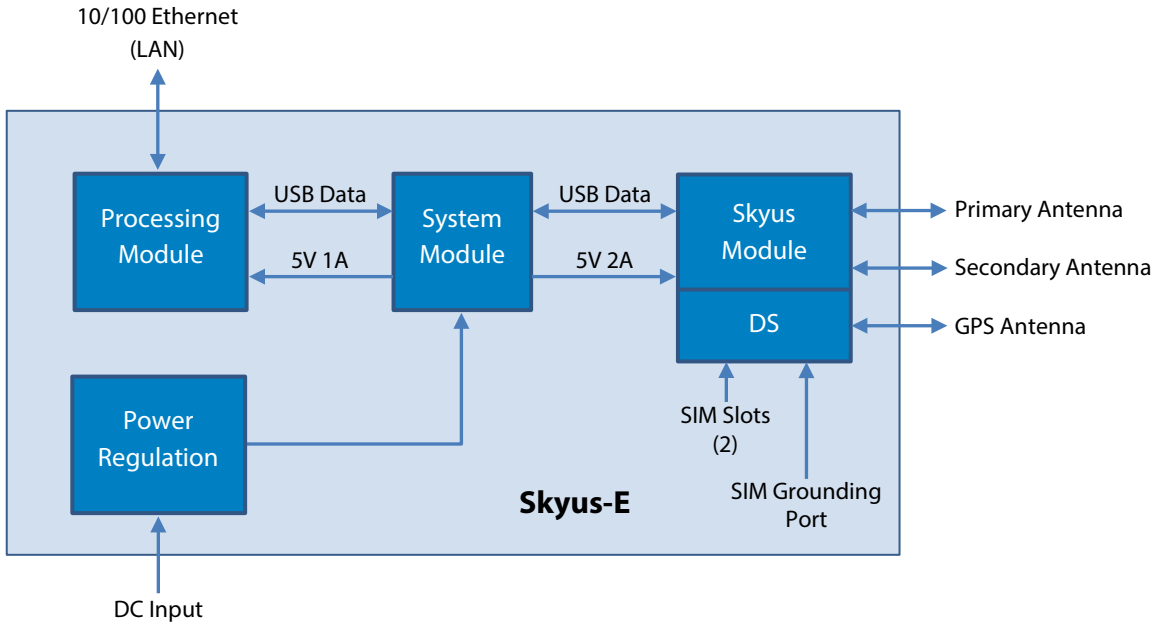

Figure 2: Skyus-E Block Diagram

Installation

The following sections describe the installation and initialization of the Skyus-E. Whether your Skyus-E is shipped with a Skyus cellular modem installed or you are installing an existing Skyus modem in the Skyus-E appliance, these instructions assume that the Skyus modem is already activated and provisioned.

Installation Summary

- Inspect the package contents and compare against the packing list.
- (Optional) Install your existing Skyus modem in the unit if necessary.
- Install the Skyus-E mounting plate and mount the unit to the plate.
- Connect the antennas.
- Connect the Skyus-E to the LAN or desired device using the an Ethernet cable.
- Connect power.
- Verify the WAN connection.
- Verify the LAN connection.
- **Recommended:** Change the default password.

Package Contents

Package contents depend on the configuration ordered. Compare the contents with the packing list. If any items are missing or damaged, contact FW support.

Item	Type	Description
Skyus-E	Included	Skyus-E IoT Appliance
Power Supply	Included	Power supply options include: AC/DC, DC/DC (bare wire or auto accessory plug), commercial or industrial temperature
Mounting Plate	Accessory	Skyus-E mounting plate
Antenna(s)	Accessory	FW offers several antennas that meet the Skyus-E antenna specifications
Ethernet	Accessory	5' Ethernet cable, RJ-45 to RJ-45
Skyus Module	Accessory	Skyus Cellular Modem (included in many Skyus-E configurations); see the Skyus Specification Sheet or the Skyus DS Specification Sheet for models

Hardware Installation

Perform the hardware installation steps described in the following sections. These instructions assume that your Skyus-E was shipped with a Skyus modem pre-installed.

- If you already have a Skyus modem and want to upgrade to the Skyus-E, contact FW Sales for the Skyus-E Retrofit kit. Complete the steps described in the Skyus-E Retrofit Assembly Instructions before proceeding with the installation.
- If you want to replace the existing Skyus modem in your Skyus-E, follow the instructions in "Appendix C: Swapping Modems" before proceeding with the installation.

Installing the Mounting Plate

The Skyus-E attaches easily to the mounting plate (sold separately). The figure below shows the dimensions and mounting hole locations of the plate. The mounting hardware you use will depend on the requirements of your enclosure. Countersunk bolts or screws may be used. "Appendix B: Mounting Plate Template" provides a full-scale template you can print and use to mark the screw hole positions.

> **Note:** The mounting plate hole spacing supports mounting to a monitor or TV using VESA standard 75 mm hole spacing if the appropriate screws are used.

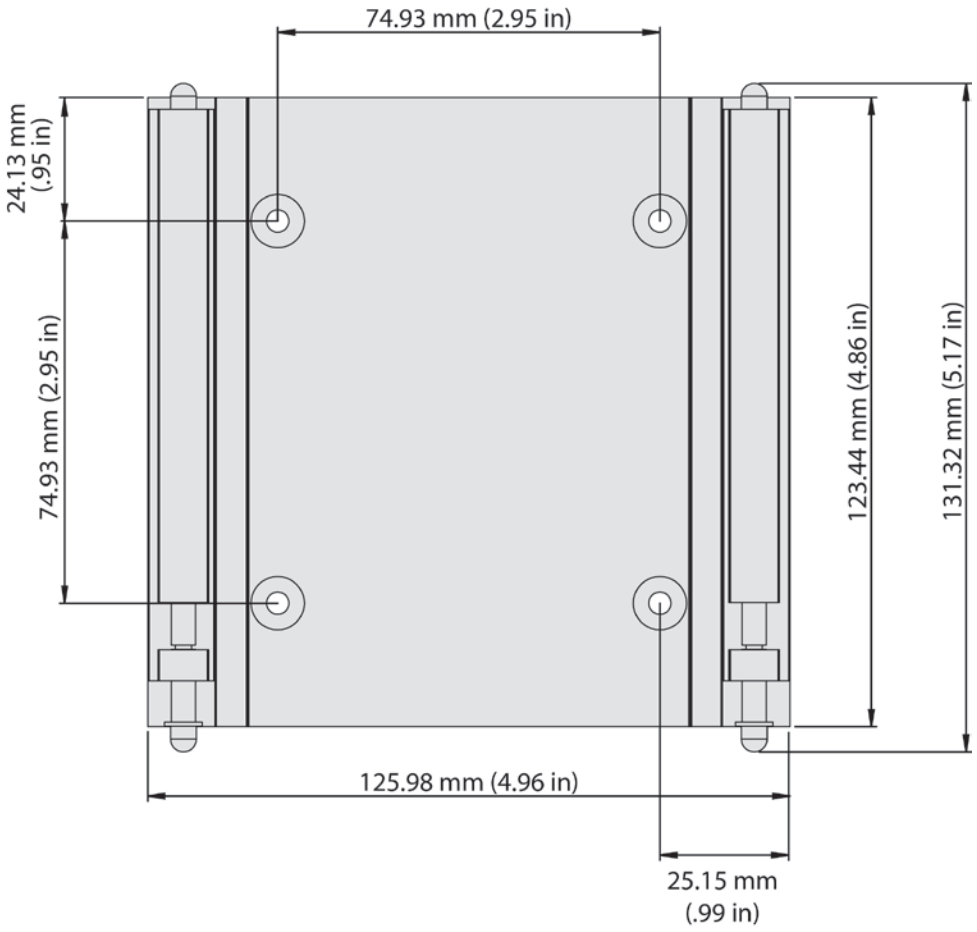

Figure 3: Mounting Plate Dimensions (Not to scale.)

The Skyus-E is mounted to the plate by placing the front or back edge of the Skyus-E over the spring-loaded pins, pulling to compress the pins, and dropping the opposite edge down over the fixed pins, as shown below. A how-to video on attaching the Skyus-E to the mounting plate is available on the Skyus-E Product Page on the FW website.

Figure 4: Attaching the Skyus-E to the Mounting Plate

Connecting Antennas

If you have questions about the appropriate cellular antennas for your Skyus-E, contact your FW representative. Antennas should be located at least 20 mm from any person. When using multiple separate antennas for MIMO or Receive Diversity, they should optimally be separated from each other by at least 20 mm.

Connect the primary cellular antenna to the SMA connector on the back panel labeled **Primary**. A second antenna can be attached to the SMA connector labeled **Diversity/AUX**. This connector is used for Receive Diversity for 3G connections or multiple-input and multiple-output (MIMO) for 4G LTE connections. Connect the GPS antenna to the SMA connector labeled **GPS**.

All SMA connectors should be tightened to 8 in-lbs. using a torque wrench with a 5/16 bit.

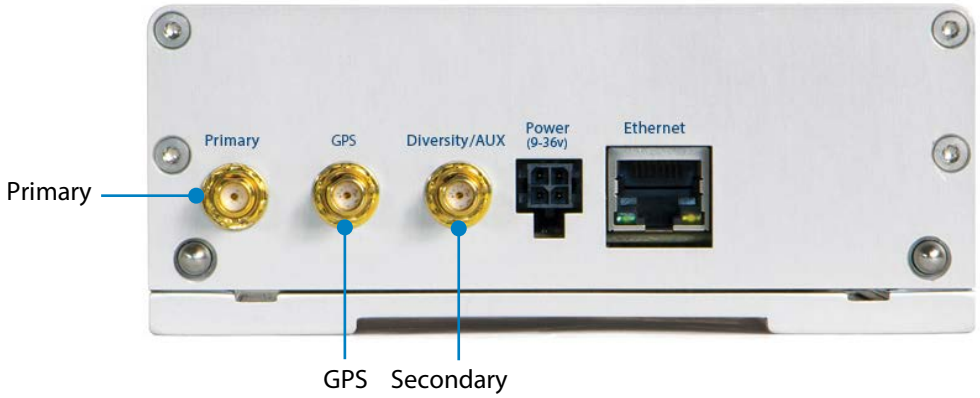

Figure 5: Antenna Connections

Connecting to the LAN

Connect a standard RJ-45 Ethernet cable into the connector labeled **Ethernet** on the back of the Skyus-E. Connect the other end of the cable to your host computer, switch, or separate router.

Connecting Power

Attach an AC/DC or DC/DC power supply to the connector labeled **Power (9-36v)** (mating connector: Molex 43025-0400) on the back of the Skyus-E. Plug the other end of the adapter into the power source. Contact FW for available power supply options. The pin assignments of the power connector are shown below. Refer to the power specifications for operating and maximum allowed voltage ranges.

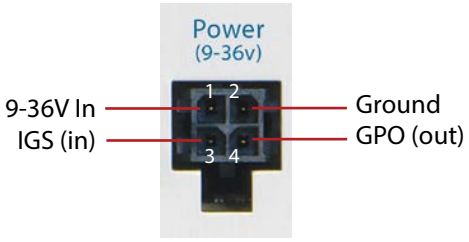

Figure 6: Power Connector Pin Assignments

Power LED

When power is applied, the **Power** LED on the front panel will flash green slowly until the boot process is complete. During normal operation, the **Power** LED will flash green quickly. The following table describes the **Power** LED modes.

LED Mode	Color	Description
Slow flashing	Green	System is booting
Quick flashing	Green	Power is applied, boot process is complete, normal operation
Solid	Red	System is in a non-recoverable unhealthy state
Flashing	Red	Over/under voltage or temperature condition

Verifying the Connections

Connection to the carrier should occur approximately 90-150 seconds after applying power. Connection time will vary according to carrier network and signal strength. The **Activity** LED lights up with activity. The **Signal Strength** LED array indicates the strength of the signal being received. The color of the LEDs depends on the connection type.

You can connect to the Skyus-E Interface via a Web browser to obtain more information about the connection status. From a computer connected to the Internet, open a browser and enter the Skyus-E IP address in the address bar. The login page of the utility displays the state, type, and up time of the connection, among other information. (See "Skyus-E Default Settings.")

See "Skyus-E Administration Interface" for complete information on monitoring, configuring, and managing your Skyus-E.

Activity LED

The **Activity** LED indicates both network activity and data usage. The following table describes the **Activity** LED modes. Note that indication of monthly data plan used is dependent upon configuring your data usage thresholds in the Skyus-E configuration. If this is not configured, the **Activity** LED will default to blue.

LED Mode	Color	Description
Intermittent flashing	Green	Skyus-E transferring data
Solid	Blue	0-50% of the monthly data plan is used
Solid	Green	51-85% of the monthly data plan is used
Solid	Yellow	86-99% of the monthly data plan is used
Solid	Red	100% of the monthly data plan is used

Signal Strength LEDs

The **Signal Strength** LED array indicates both the strength of the cellular signal and the type of connection. The array follows the standard 1-4 bar signal strength scheme, with four bars indicating a strong signal. The following table describes the **Signal Strength** LED modes.

LED Mode	Color	Description
1-4 bars lit	Blue	4G connection
1-4 bars lit	Green	3G connection
1-4 bars lit	Yellow	2G connection
0 bars lit	—	No connection

Resetting the Skyus-E

The **Reset** button on the Skyus-E front panel performs two different reset functions. The type of reset performed depends on how long the button is held down. When the button is pressed and held down, the signal strength LEDs will flash specific colors three times to indicate the type of reset that will be performed when the button is released.

CAUTION: Do not remove power to the Skyus-E or disconnect interface cables during a reset. Wait until the device is fully reset and the connection has been reestablished. Failure to wait might compromise the device.

NOTE: The reset button is functional only when the **Activity** LED is lit. Pressing the reset button will have no effect when the **Activity** LED is not lit.

To press the button, use a narrow tool such as a precision screwdriver or the end of a paperclip.

Reset Type	Button Press*	LED Flash Color	Description
Soft	5 seconds	Green	Resets the system using the current settings. This is similar to removing and reapplying power to the Skyus-E.
Factory Default	10 seconds	Red	Resets the system to the as-shipped settings.†

** Approximate duration of press.*
† Does not reset firmware to factory settings. Any after-purchase firmware upgrades will remain intact.

After a reset, restart your browser to reload the Skyus-E Interface and ensure that the latest settings are displayed.

Skyus-E Administration Interface

The Skyus-E Administration Interface is an all-purpose administrative tool that provides an intuitive Web interface for monitoring, configuring, and managing the Skyus-E. From the interface you can check the status of your connections to the WAN and LAN, view the status of the Skyus-E hardware, configure network and security settings, add users , set permission levels, and create and view system logs, among other activities.

Supported browsers are Chrome, Opera, and Firefox. Use of Internet Explorer 10 or newer may result in less than optimal interface performance; earlier versions of Internet Explorer have not been tested.

> **Note:** The screenshots depicted in the following sections are examples only. The actual data displayed depends on the configuration and status of your Skyus-E.

Skyus-E Default Settings

The following table provides the default system settings you will need to access the Skyus-E Interface.

Parameter	Default Setting
Skyus-E Local URL	http://192.168.66.1
Username	admin
Password	fw*xxxxxx* where *xxxxxx* is the last six digits of the MAC address not including dashes or colons (shown on the utility login page)
Local Port	80
Remote Port	8080

Logging In

To log in to the Skyus-E Interface, open a browser on a computer connected to the Internet, and type the Skyus-E IP address into the address bar. The interface login page displays, as shown below. A summary of the current status of the Skyus-E appears on this page for quick reference.

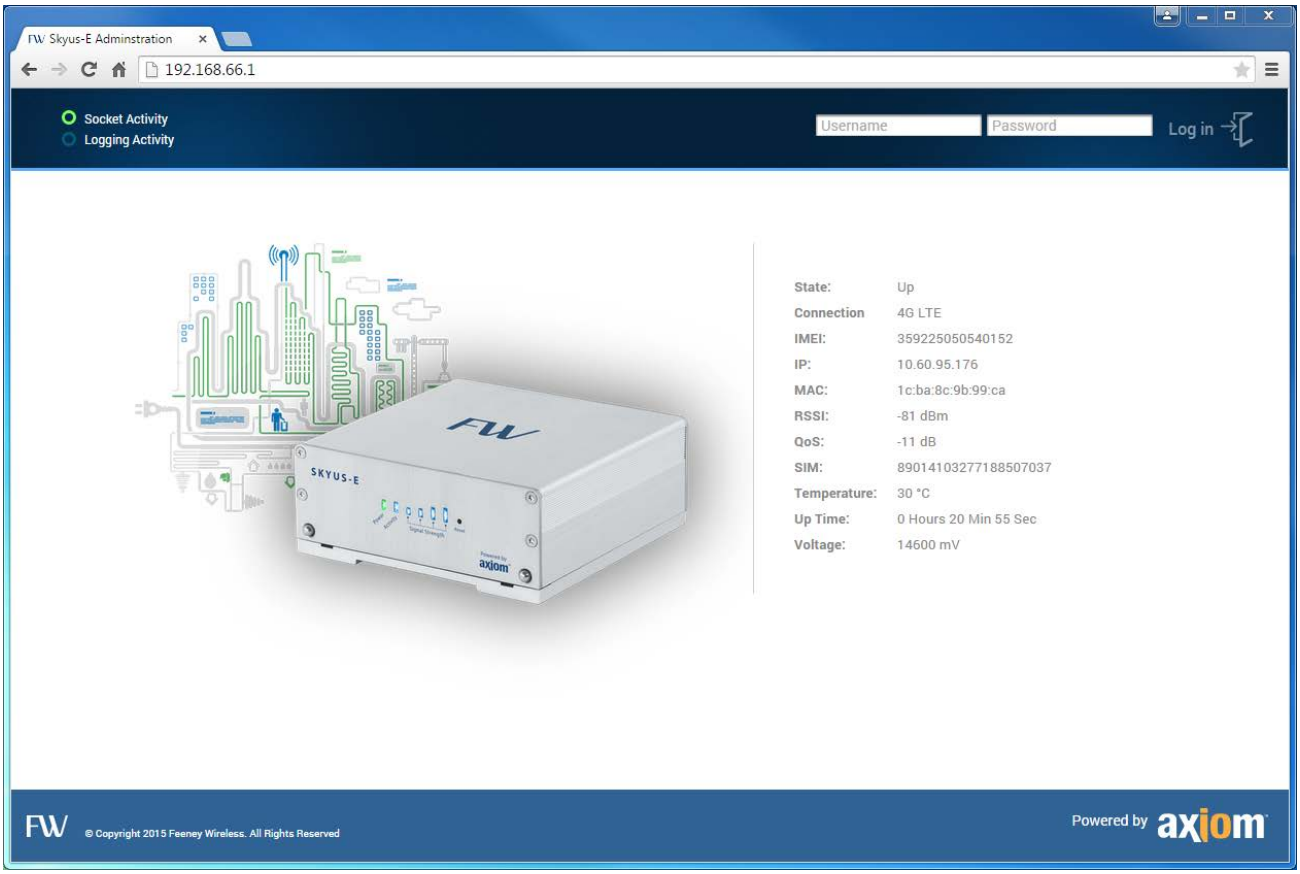

Figure 7: Skyus-E Web Interface Login Screen

Enter the default username and password and click the **Log in** icon. The default username and password are:

Username: admin
Password: fw*xxxxxx*

Where *xxxxxx* is the last six characters of the MAC address (excluding separators). It is recommended that you change the default password. The password can be changed on the Administration > User tab.

To log out, click the **Log out** icon on any page. The Skyus-E Interface will automatically log out after about 10 minutes of inactivity.

Remote Access to the Skyus-E Interface

The Skyus-E Interface can also be accessed remotely if your Skyus has been assigned a publicly routable IP address from your cellular carrier. To access the Skyus-E remotely, the default port is 8080. Access the Skyus-E using the following URL:

http://<IP assigned from your carrier>:8080

Note: The same user cannot be logged in on multiple devices. If your application requires multiple users to manage the Skyus-E, you can add and manage users on the **User** tab (see "User").

Skyus-E Banner

After logging in to the Skyus-E Interface, the banner will display connection information including: the signal type, signal strength, and activity, as shown below.

Figure 8: Skyus-E Interface Banner

- Signal Strength – This indicator matches the Signal Strength LEDs on the Skyus-E. The number of bars indicates signal strength and the color indicates data usage.
- Signal Type – This is the name of the cellular carrier to which the Skyus-E is connected.
- Socket Activity – This indicator flashes with connection activity to the Skyus-E.
- Logging Activity – This indicator will be lit if the logging function of the Skyus-E has been turned on.

Status

The Status page provides information about the Skyus-E device, connection status and statistics, and the basic state of the system.

To access this page, click **Status** in the navigation panel. Information on this page is organized under four tabs: Dashboard, Cellular, Statistics, and System.

Dashboard

This tab provides a summary of Skyus-E status similar to the summary that appears on the login page. It also displays any current alerts and notifications.

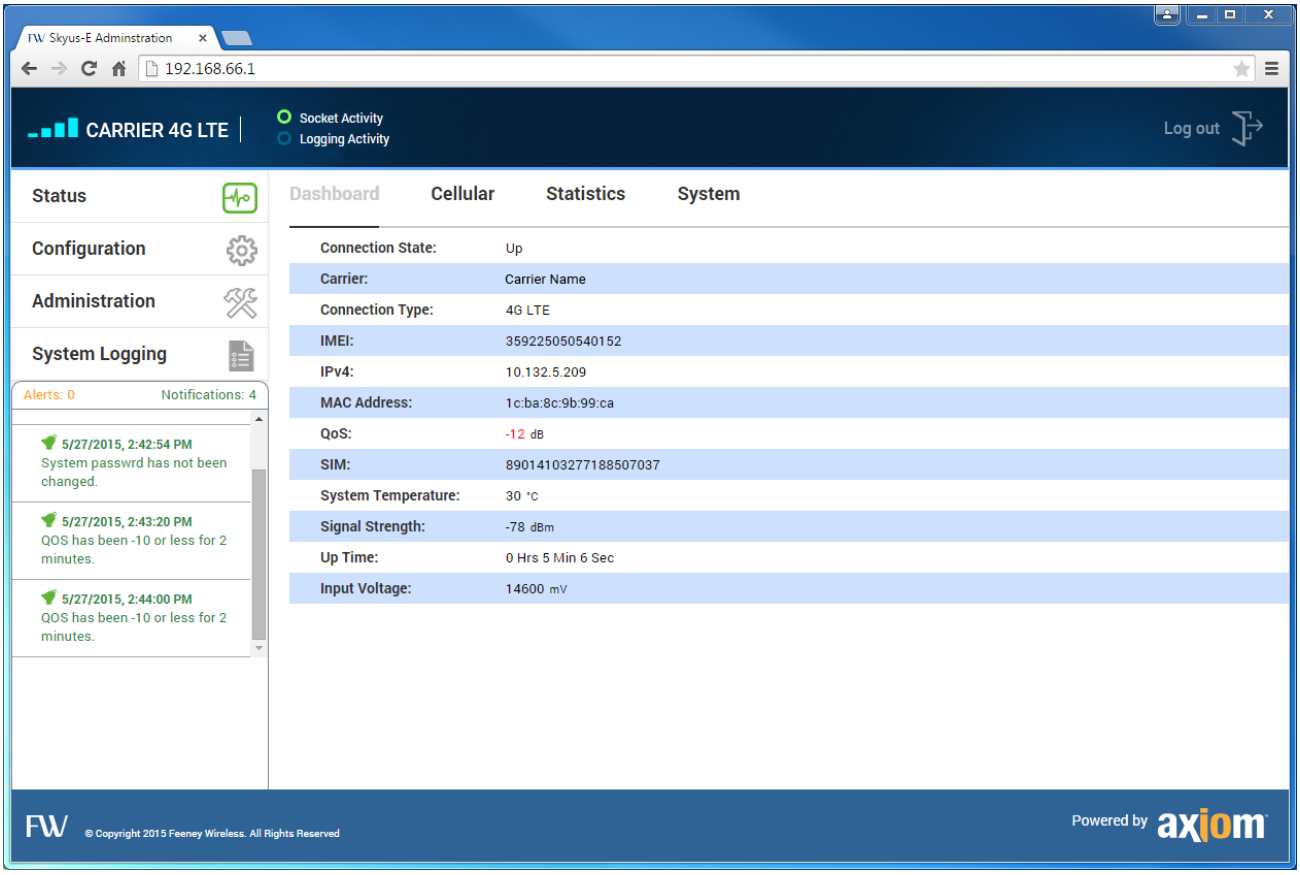

Figure 9: Dashboard Tab

Field	Description
Connection Status	Values: Up, Down. Reports whether or not a connection to the cellular carrier is up or down. The connection is reported as up if an IP address has been assigned and a ping (ICMP) check to a URL or IP as configured under Network > Connection > Ping URL or Alt Ping URL is successful.
Carrier	Name of the cellular carrier in use, such as AT&T, Sprint, T-Mobile, Verizon, etc.
Connection Type	Type of cellular connection, such as 4G LTE and others.
IMEI	IMEI number of the Skyus radio module. The IMEI is often required when attempting to activate a Skyus with a cellular carrier.
IPv4	WAN IP address of the Skyus-E when connected to a cellular data network.
MAC Address	MAC address of the Skyus-E Ethernet interface. A MAC address is a unique identifier and thus can be useful when creating MAC address filtering rules.

Field	Description
QoS (Quality of Service)	Signal quality in dB. Quality of Service (QoS) is a measure of the quality of the cellular signal as compared to interference and noise. Optimal values vary dependent on cellular network type, but generally a value consistently less negative than -10 dB indicates a lack of excessive noise or interference. The QoS value can be useful to refer to when troubleshooting connection reliability issues, packet loss, or low bandwidth. When QoS is consistently poor, the value is displayed in red.
SIM	Unique identification number of the SIM inserted into the Skyus, also referred to as an ICCID. This identifier is often needed when activating a Skyus with your cellular provider.
Temperature	Temperature of the Skyus radio module within the Skyus in degrees Celsius.
Signal Strength	Strength of the cellular network signal in dBm. When connected to an LTE network the value reported is the RSRP (Reference Signal Received Power) and when connected to any other network type the value reported is the RSSI (Received Signal Strength Indicator). This value is useful when troubleshooting coverage or connection reliability and performance issues.
Up Time	Total time the Skyus-E has been powered up since the last power cycle or reboot.
Voltage	Voltage in mV (millivolts) detected at the Skyus-E power jack. The Skyus-E can operate normally between 9-36V DC, which is equivalent to 9000 to 36000 mV DC. Note that in vehicle environments the Skyus-E can be configured to shut down at voltages above the 9V minimum operating voltage threshold to protect the health of the vehicle battery.

Cellular

This tab provides information about your cellular carrier and connection status.

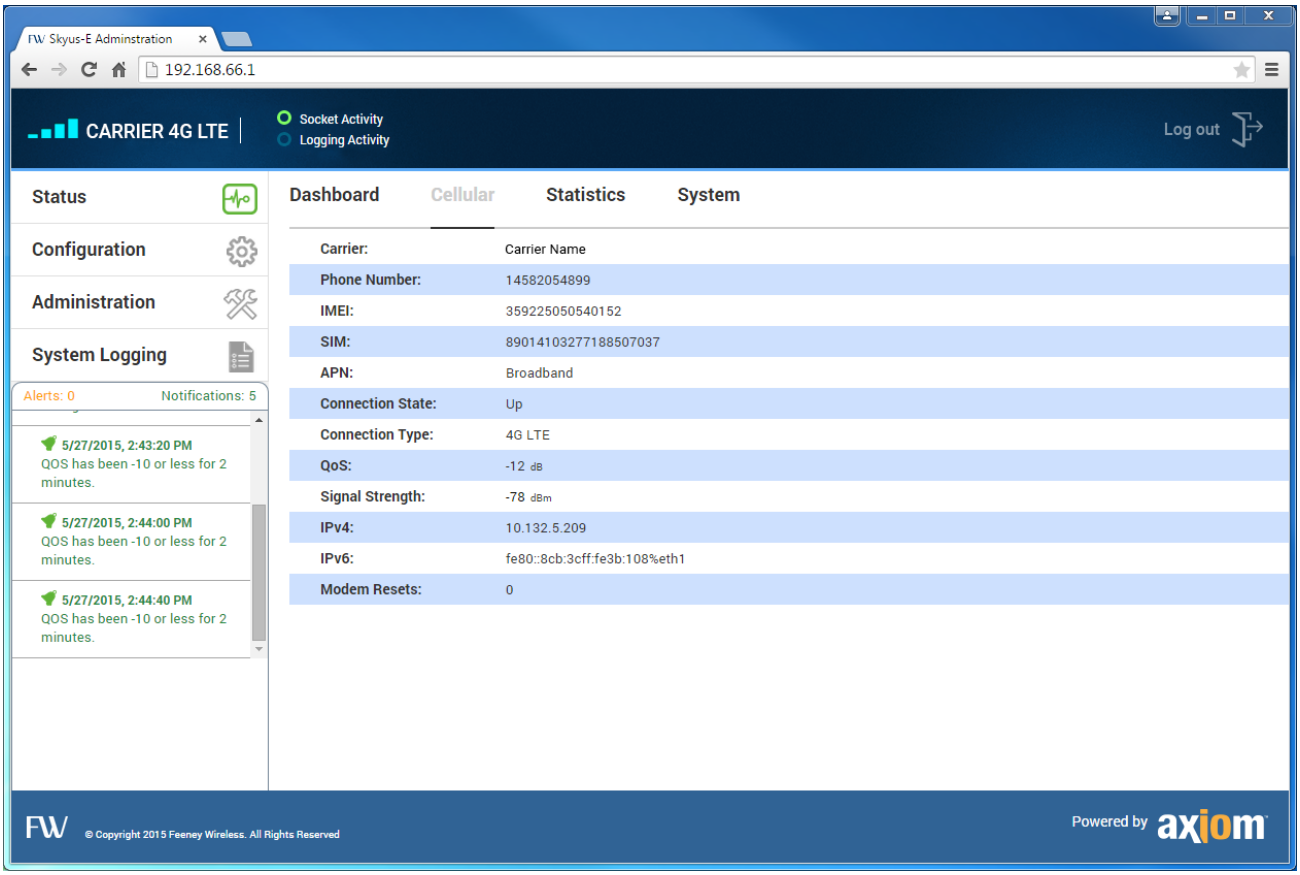

Figure 10: Cellular Tab

Field	Description
Carrier	Name of the cellular carrier in use, such as AT&T, Sprint, T-Mobile, Verizon, etc.
Phone Number	Phone number (programmed into the device) associated with the carrier account.
IMEI	IMEI number of the Skyus radio module. The IMEI is often required when attempting to activate a Skyus with a cellular carrier.
SIM	Unique identification number of the SIM inserted into the Skyus, also referred to as an ICCID. This identifier is often needed when activating a Skyus with your cellular provider.
APN	Current Access Point Name (APN) in use by the network connection.
Connection State	Values: Up, Down. Reports whether or not a connection to the cellular carrier is up or down. The connection is reported as up if an IP address has been assigned and a ping (ICMP) check to a URL or IP as configured under Network > Connection > Ping URL or Alt Ping URL is successful.
Connection Type	Type of cellular connection, such as 4G LTE and others.

Field	Description
QoS (Quality Of Service)	Signal quality in dB. Quality of Service (QoS) is a measure of the quality of the cellular signal as compared to interference and noise. Optimal values vary dependent on cellular network type, but generally a value consistently less negative than -10 dB indicates a lack of excessive noise or interference. The QoS value can be useful to refer to when troubleshooting connection reliability issues, packet loss, or low bandwidth. When QoS is consistently poor, the value is displayed in red.
Signal Strength	Strength of the cellular network signal in dBm. When connected to an LTE network the value reported is the RSRP (Reference Signal Received Power) and when connected to any other network type the value reported is the RSSI (Received Signal Strength Indicator). This value is useful when troubleshooting coverage or connection reliability and performance issues.
IPv4	WAN IP address of the Skyus-E when connected to a cellular data network.
IPv6	Internet Protocol version 6 (IPv6) address of the Skyus-E (if applicable).
Modem Resets	Number of times the modem has reset since the Skyus-E was last powered on.

Statistics

This tab displays information about the amount of data sent and received over the WAN and LAN. It allows you to view bandwidth usage over a specified range.

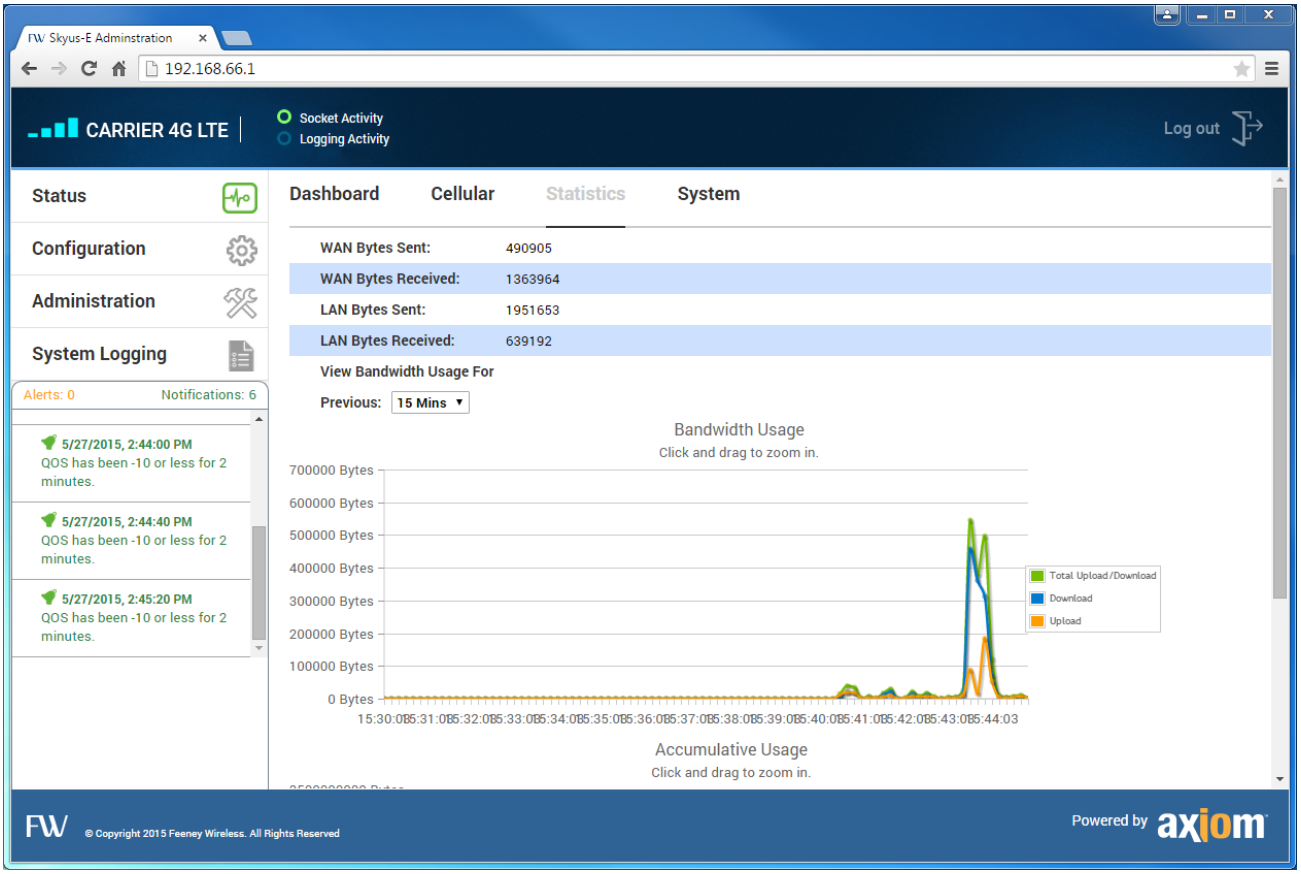

Figure 11: Statistics Tab

Field	Description
WAN Bytes Sent	Number of bytes sent during the current connection session with the cellular carrier. This is also referred to as the “upload” direction.
WAN Bytes Received	Number of bytes received during the current connection session, also referred to as the “download” direction.
LAN Bytes Sent	Number of bytes sent from the Skyus-E LAN Ethernet interface.
LAN Bytes Received	Number of bytes received on the Skyus-E LAN Ethernet interface.
View Bandwidth Usage For Previous	The Bandwidth Usage chart provides an extremely useful visualization of data usage and bandwidth trends over a selectable period. You can select the last 15 minutes, last hour, last day, last 7 days, and the last 30 days. By clicking the various names of the values reported, the chart can be changed to report only specific items of interest.

System

This tab provides hardware and component information.

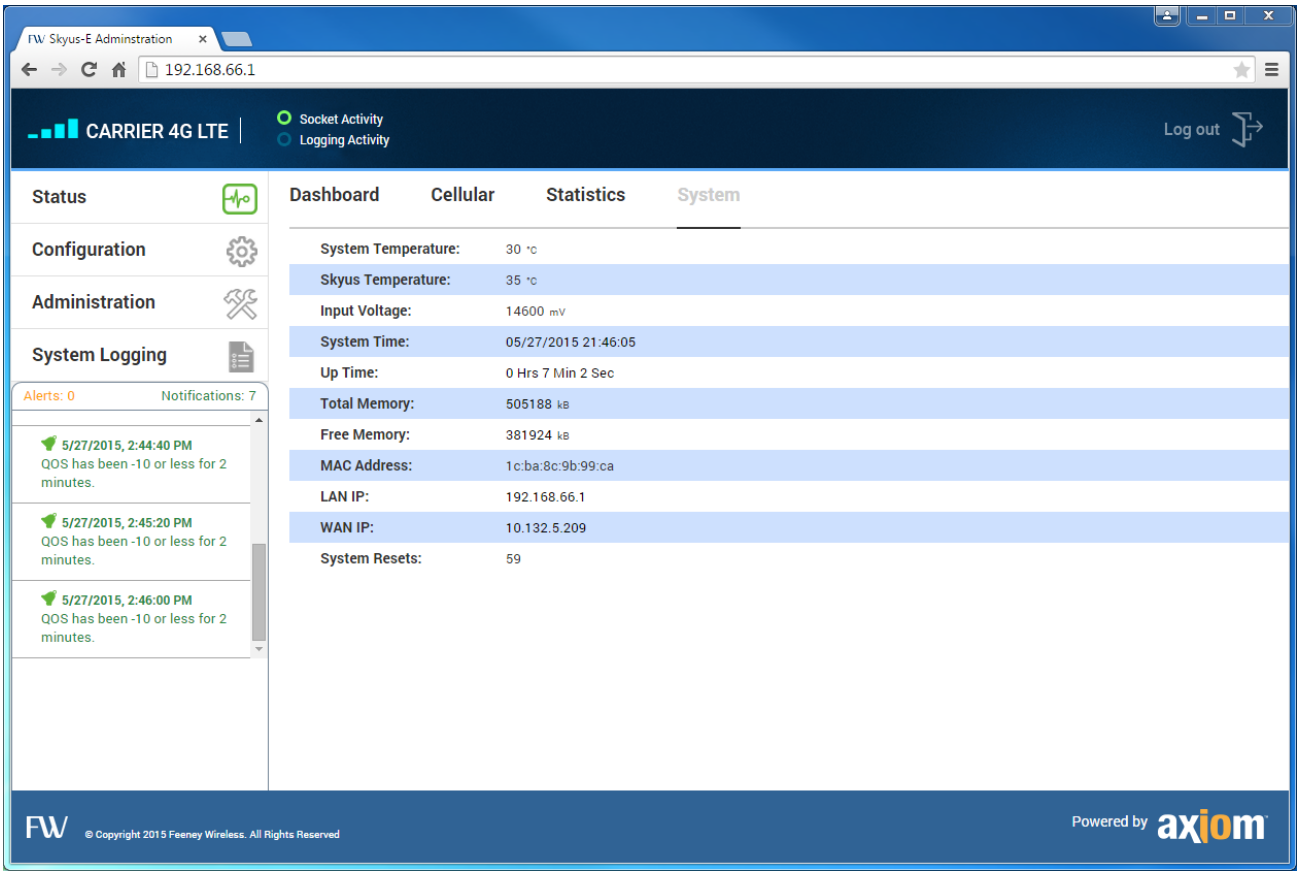

Figure 12: System Tab

Field	Description
System Temperature	Temperature within the Skyus-E in degrees Celsius as detected by the system module. Alerts will be generated if the temperature exceeds the recommended operating temperature range of the Skyus E.
Skyus Temperature	Temperature of the Skyus radio module within the Skyus in degrees Celsius.
Input Voltage	Voltage in mV (millivolts) detected at the Skyus-E power jack. The Skyus-E can operate normally between 9-36V DC, which is equivalent to 9000 to 36000 mV DC. Note that in vehicle environments the Skyus-E can be configured to shut down at voltages above the 9V minimum operating voltage threshold to protect the health of the vehicle battery.
System Time	Current date and time: MM/DD/YYYY HH:MM:SS. The Skyus-E uses the Coordinated Universal Time (UTC) standard.
Up Time	Total time the Skyus-E has been powered up since the last power cycle or reboot.
Total Memory	Amount of RAM in kilobytes present in the Skyus-E. The current version has 505,188 KB of useable memory.
Free Memory	Amount of RAM free to the operating system. Free Memory can be a useful point of reference in troubleshooting Skyus-E performance issues.
MAC Address	MAC address of the Skyus-E Ethernet interface. A MAC address is a unique identifier and thus can be useful when creating MAC address filtering rules.
LAN IP	The current IP address of the Skyus-E.
WAN IP	Current WAN IP address of the device, generally obtained from your carrier. This is the address you can use to contact the Skyus-E from the Internet if your assigned IP is routable.
System Resets	The number of times power has cycled on the Skyus-E.

Configuration

The Configuration page provides the ability to manage network settings, create and manage APN profiles, determine connection behavior, enable general purpose output (GPO), and manage ignition sense (IGS) settings.

To access this page, click **Configuration** in the navigation panel. Information on this page is organized under four tabs: Network, APN, Connection, and GPO/IGS.

Network

This tab provides the ability to manage DHCP and LAN settings, and add rules for the firewall, port forwarding, routing, and MAC filtering.

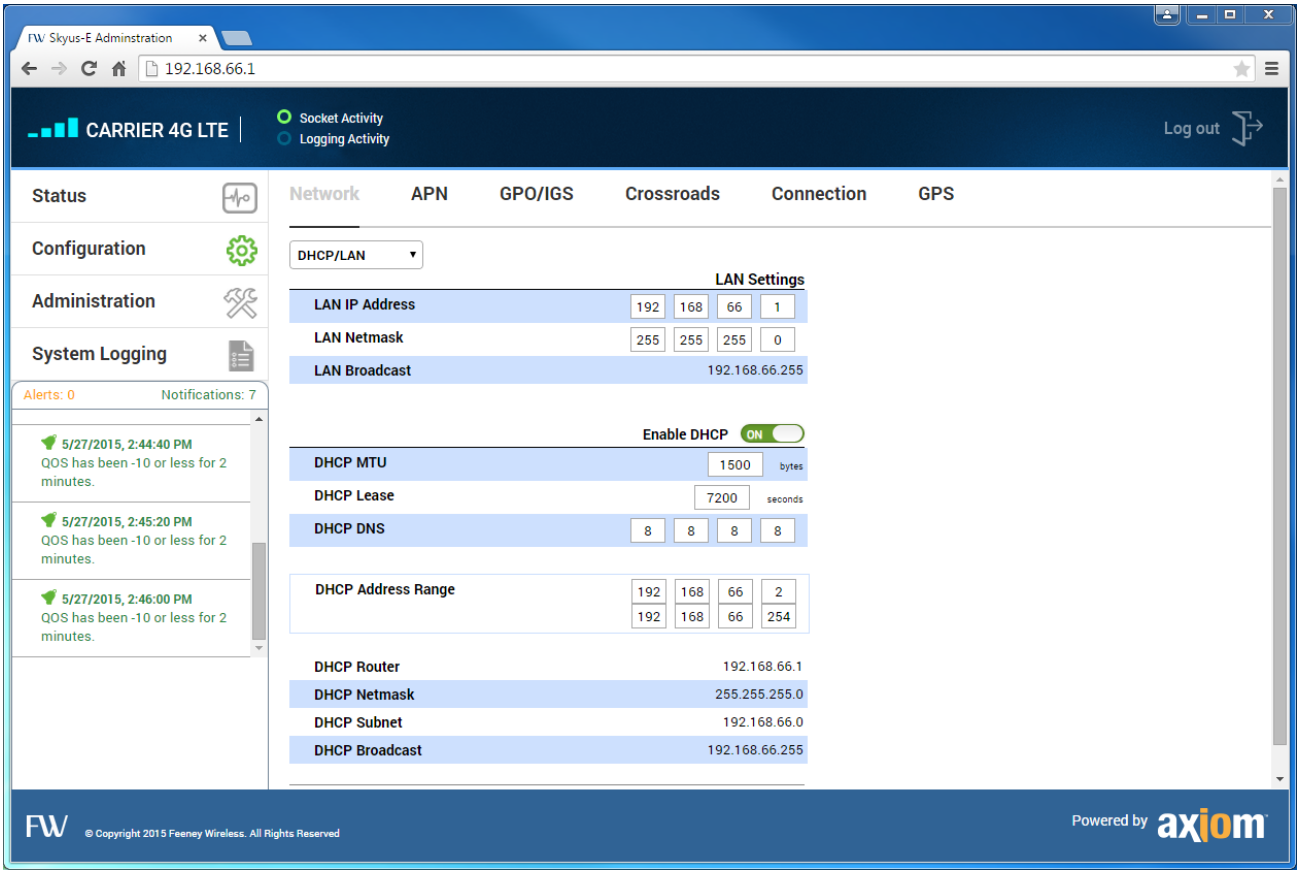

Figure 13: Network Tab

Field	Description
DHCP	
DHCP/LAN	Drop-down list to select between DHCP/LAN settings, Firewall rules, Port Forwarding rules, or Routing Rules.
Enable DHCP	Switch to enable or disable Dynamic Host Configuration Protocol (DHCP). DHCP is enabled by default.
DHCP Router	Current router IP address.
DHCP Netmask	Current netmask.
DHCP Broadcast	Current broadcast.
DHCP DNS	Current Domain Name System (DNS) name.
DHCP MTU	Slider to set the maximum DHCP transmission unit (MTU) in bytes. Range: 1400-1500.
DHCP Lease	Slider to set the DHCP lease period in seconds. Range: 1800-7200 seconds.
DHCP Address Range	Current DHCP IP address range.

Field	Description
LAN Settings	
LAN Address	Current LAN IP address.
LAN Netmask	Current LAN netmask.
LAN Broadcast	Current LAN broadcast.
Firewall (See "Creating Firewall Rules")	
Add Firewall Rule	Opens a dialog to create a firewall rule. • Common Services: HTTP, HTTPS, FTP, Telnet, SSH, DNS. Selecting a service automatically places values in the From, Port, and Protocol fields. • Logging: Checkbox to enable logging. • Number: Firewall rule number. This is the position in the rule list where the new rule is to be placed. Rules at the top of the list are evaluated first. By default, new rules are automatically given a number that puts the new rule at the bottom of the list, but this can be changed by the user. • Rule: allow, deny, reject. • Dir (direction): in, out. • From: any, or a specific port number. • Protocol: tcp/upd, tcp, upd
Port Forwarding (See "Creating Port Forward Rules")	
Add Port Forward Rule	Opens a dialog to create a port forwarding rule. • Number • Name: Any name. • Outer Port • Inner Port • IP Address: Desired LAN IP address to forward traffic to. • Protocol: tcp, upd, tcp/upd
Routing (See "Creating Routing Rules")	
Add Routing Rule	Opens a dialog to create a static routing rule. • Destination: Network. • Subnet: Subnet. • Gateway: IP on the Skyus-E LAN to route through.

Creating Firewall Rules

The Skyus-E supports the creation of *firewall rules* to either block or allow certain types of IP traffic. Firewall rules can be configured to Allow, Deny, or Reject IP traffic to or from specific servers (IPs) or groups of IPs. You can optionally choose to filter IP traffic based on specific ports and protocols.

Figure 14. Firewall Rules

1. Click **Add Firewall Rule**. The **Firewall** dialog box opens.

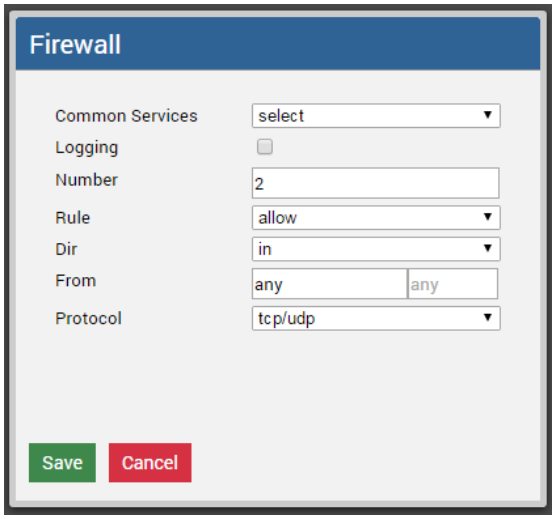

Figure 15: Firewall Dialog Box

   Selecting a value in the **Common Services** field (HTTP, HTTPS, FTP, Telnet, SSH, or DNS) automatically selects values for the From, Port, and Protocol fields. You can choose to include this firewall rule in system logging by checking the **Logging** box.

2. When adding or modifying a firewall rule, first define the position on the list of firewall rules in which the new rule should be evaluated. Do this by modifying the value in the **Number** field.

   By default each new rule will be placed at the bottom of the list. Rules at the top of the list take priority over rules at the bottom. This is important and useful if, for example, you want to create a set of firewall rules to accept specific IP traffic and reject all other IP traffic. The rules to accept the traffic should be at the top of the list.

3. Next, in the **Rule** field, choose whether to **allow**, **deny**, or **reject** the IP traffic that matches the rule criteria.

- Traffic matching an **allow** rule will be routed to the appropriate host or server.
- Traffic matching a **deny** rule will be silently dropped by the firewall with no notification given to the sending server or host. In most cases this is the recommended method for denying specific IP traffic as it provides no information to a potential attacker that could be useful in mapping any existing firewall rules.
- Traffic matching a **reject** rule will be dropped by the firewall, and the server or host sending the IP traffic will receive an ICMP Port Unreachable message. A reject rule can be useful to alert the sender of the traffic that a firewall is present and configured to block specific types of traffic.

By default all traffic is allowed outbound from hosts on the Skyus-E LAN to servers. Inbound traffic from the Internet to hosts and devices behind the Skyus-E on its LAN will not be routed to devices or hosts on the Skyus-E LAN unless an appropriate *Port Forwarding* rule is created (see "Creating Port Forwarding Rules").

Creating a Port Forwarding rule to an internal host or device will automatically create the corresponding Firewall allow rule on the defined IP port and protocol. In some cases, it may be desired to create an additional Firewall rule to restrict the list of IP addresses or ranges of IP addresses the Port Forwarding rule applies to. In this case, create the appropriate **accept**, **deny**, and **reject** rules as desired to complement the automatically generated **accept** rule on the port and protocol.

EXAMPLE: A specific example would be the creation of a rule to allow Port Forwarding to an IP camera to allow remote viewing of video where additional Firewall rules are desired to only allow access to the camera from trusted IPs representing a trusted customer network.

4. In the **Dir** field choose either **in** or **out** to match the traffic direction the rule should be evaluated against.

    - Choosing **in** will match IP traffic coming (originating) from hosts and servers on the Internet (or Private Network). Creating an **in** direction rule is useful to restrict access to specific devices or hosts located on the Skyus-E LAN coming from the Internet. The camera example in the previous note is a use case for an **in** rule.
    - Choosing **out** will match IP traffic coming from a host or device located on the Skyus-E LAN, such as a laptop or router connected to the Skyus-E Ethernet port. An **out** rule can be used to **allow**, **deny**, or **reject** IP traffic going to servers on the Internet.

    EXAMPLE: It may be desired to block Web browsing to www.webpage.com or an IP address such as 20.30.240.50. To do this, a direction of **out** should be selected in this step.

5. In the field noted as either **From** for an in direction rule or **To** for an out direction rule, as defined in step 3, you can enter either a URL or an IP address.

    This field defines the IP address, or a number of IP addresses when a URL is entered, to which the rule applies. In this field you may enter information in one of multiple formats. To create a rule matching all IP addresses, leave the default of **any** in this field.

    - A single IP address, such as 192.168.66.100.
    - An IP address noting a specific network and corresponding subnet mask. To utilize this method the syntax to use is *IP address/subnet mask*. For example, to create a rule matching all traffic to an IP range of 192.168.66.X you can enter 192.168.66.0/255.255.255.0 in the **From** or **To** field.

- An IP and *slash notation* subnet. To take the same example as above, to match all traffic to or from 192.168.66.X you may enter 192.168.66.0/24. Slash notation is a convenient shorthand to enter a subnet mask and is based on the decimal equivalent of the number of "1"s in the subnet mask. For commonly used subnet masks: 255.255.255.0 equals /24, 255.255.0.0 equals /16, and 255.0.0.0 equals /8.
- A URL such as www.feeneywireless.com. If a URL is entered, a DNS lookup will be performed and the appropriate rules will be created that match all IPs returned from DNS for that URL. Note that for large sites such as www.google.com that employ load balancing, this might not effectively block all traffic, due to the dynamic nature of IPs that may be in use at any point in time.
- The special value of **any**. This is the default and matches all traffic to any IP address.

6. Enter a specific desired *TCP*, *UDP*, or *TCP & UDP* port as defined in the next step. The port can also be left as the default of **any** to match all ports for the IP or URL defined in step 4. The port should be entered in the field to the right of the IP address or URL.

   In this step it is possible to define a specific port to match in the Firewall rule. It may be valuable to refer to online information noting commonly used ports for various services. FW has provided a convenient commonly used services option at the top of the firewall entry dialog box.

   The appropriate syntax in this step is either a specific numeric port ranging from 1 to 65535 or the default of **any** to match all ports. To create rules matching a range of ports it is necessary to create multiple firewall rules. Commas or non-numeric characters other than "any" should not be used in this field.

7. Enter the IP protocol to match the Firewall rule against. The allowed options are the default of **tcp / udp** or only **tcp** or **udp.**

   NOTE: Generally, users can safely leave this at the default of **tcp / udp** to match the rule against either protocol.

Creating Port Forwarding Rules

The Skyus-E supports *Port Forwarding* functionality. Port Forwarding is designed to allow inbound IP traffic to be routed to a host or device on the Skyus-E LAN. The use of Port Forwarding is closely related to the creation of appropriate Firewall rules. Refer to "Creating Firewall Rules" for more detail related to the creation of Firewall rules to restrict the allowed hosts which can access an attached device via the use of Port Forwarding rules.

Figure 16. Port Forwarding Rules

Typical applications of Port Forwarding include:

- Remote viewing of video from a webcam (camera) connected to the Skyus-E Ethernet port.
- Remote management of devices such as PCs or routers connected to the Skyus-E Ethernet port.

To make use of Port Forwarding in most cases, a publically routable static IP address may be necessary or desirable. In these cases you may wish to engage FW Support for assistance or work directly with your chosen cellular carrier to assign a "publicly routable static IP address."

Public Static IP addresses are available from Verizon, Sprint, and AT&T, but are generally not the default option for data devices such as the Skyus. A publicly routable static IP address is one in which the IP address assigned when the Skyus connects to the carrier network is unchanging and does not block or restrict most traffic from any other Internet address.

In some use cases where maximum security is required, the use of "Private Networking" or "Restricted Static Addresses" can also provide an unchanging IP address to the Skyus to support Port Forwarding. This provides the added benefit of additional security through restrictions on what other networks or Internet IP addresses can communicate with the Skyus. FW field engineering staff offer consulting services to help our customers best identify and implement optimal solutions in these types of projects.

To configure Port Forwarding rules follow the steps below.

1. Click **Add Port Forwarding Rule**. The **Port Forward** dialog box opens.

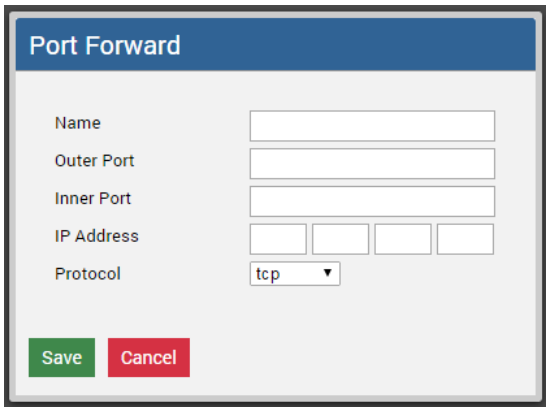

Figure 17: Port Forward Dialog Box

2. Choose a name for the Port Forwarding rule to identify it.

   It is recommended that you choose a name that describes the application the rule is enabling, such as "Camera Web Access." The name of the rule has no effect on the rule itself.

3. Enter the TCP or UDP port number you will use to access the device remotely into the **Outer Port** field.

   The **Outer Port** refers to the port the Skyus-E will forward from its cellular WAN interface to an attached host or device connected to its LAN Ethernet port. Valid ports are numeric values ranging from 1 to 65535 only and should not include any non-numeric digits, such as a comma.

4. Enter the TCP or UDP port the traffic will be routed to on the attached host or device in the **Inner Port** field.

   If the **Inner Port** entered differs from the **Outer Port,** the Skyus-E will perform *Port Translation* as well as *Port Forwarding*. Port Translation is designed to support the use of a different external port number that can be used to access devices that may not support changing the TCP or UDP port the desired service or application they support "listens" on.

   Use Cases

   There are several common use cases of Port Translation combined with Port Forwarding, such as:

   - Most cellular carriers block several of the most commonly used ports for HTTP (TCP 80), HTTPS (TCP 443), and SMTP (TCP 25). This may affect certain applications such as the use of IP cameras or the Web interfaces of various devices. In these scenarios the two available solutions are to either modify the configuration of the device to use a different port number or to utilize Port Translation as detailed above to translate to a port that is not blocked by the carriers to the default port of your device which would be blocked.

     For example, consider the use case of a Web camera with a Web interface configured as typical using the default HTTP and HTTPS ports of 80 TCP and 443 TCP. These two ports are blocked in the inbound direction by all major US cellular carriers. In this case there are two potential solutions. You can either modify your camera configuration to use different ports such as 8080 TCP and 8443 TCP with a pair of basic Port Forwarding rules where both the Outer and Inner port in the rules created are 8080 and 8443 respectively, or you could use Port Translation in combination with

Port Forwarding and keep your camera configuration unchanged.

To accomplish this, create a rule with 8080 TCP for the outer port and 80 TCP for the inner port, as well as a second rule for 8443 TCP outer port and 443 TCP inner port. Either solution will allow the camera to function as expected for remote viewing, but the use of port translation does not require modifying the camera configuration settings for HTTP and HTTPS ports from their defaults, making future maintenance of the Web camera easier.

- Consider a use case where multiple Web cameras are connected via an Ethernet switch to the Skyus-E where all cameras have a default HTTP port of 80 TCP.

  For example purposes, assume three cameras are used with IP addresses on the Skyus-E LAN network of 192.168.66.100, 192.168.66.110, and 192.168.66.120. By creating three Port Forwarding rules using Port Translation, it is possible to keep all three cameras configured to remain using TCP 80 for their HTTP Web interfaces.

  To do this, create a rule called “Camera 1” with an Outer Port of 8080 TCP and inner port of 80 directed to 192.168.66.100. Create a “Camera 2” rule with an outer port of 8081 TCP and inner port of 80 directed to 192.168.66.110. Lastly, create a “Camera 3” rule with an outer port of 8082 TCP and an inner port of 80 directed to 192.168.66.120. The result of these three rules would allow you to access all three cameras on TCP ports 8080, 8081, and 8082 respectively via the Skyus-E WAN interface assigned by your cellular carrier.

5. Select **TCP & UDP**, **TCP**, or **UDP** for the protocol.

   In most cases it is common to simply select the default of **TCP & UDP**.

6. Enter the IP address of the device connected to the LAN interface of the Skyus-E.

   It is typical when using port forwarding to manually set the IP address of the device the Port Forwarding rule is directing IP traffic to “statically.” This prevents any possibility of that device’s assigned IP address changing under certain scenarios. If DHCP is used the Skyus-E may assign a different IP address after a power cycle or reboot. In addition, if multiple devices are connected using an Ethernet switch you may find that the IP address assigned via DHCP to a given device will not be consistent from power cycle to power cycle. Alternatively, if only one device will ever be connected to the Skyus-E LAN Ethernet interface you may wish to reduce the size of the DHCP pool to a single IP address in the Network > DHCP Pool settings.

7. Save the rule.

After saving your Port Forwarding rule you should see it appear on the list of currently defined port forwarding rules.

The order of the Port Forwarding rules do not matter unless multiple rules are bound to the same external port, in which case the rule highest on the list will take precedence. In this case it is recommended that you take advantage of the Port Translation functionality in the Skyus-E to choose a unique Outer Port for each device a Port Forwarding rule is required to support for a desired application.

Creating Routing Rules

Creating static routing rules can be useful to instruct the Skyus-E to route traffic to specific networks through another router or gateway on the Skyus-E LAN subnet.

Figure 18. Routing Rules

To create a routing rule:

1. Click **Add Routing Rule**. The **Routing** dialog box opens.

Figure 19: Routing Dialog Box

2. Enter addresses for the **Destination**, **Subnet**, and **Gateway**.

   EXAMPLE: If another router is connected to the Skyus-E Ethernet port and assigned an IP address of 192.168.66.100 and this second router has other subnets such as 192.168.1.0/24, then creating a static route to 192.168.1.0/24 pointing to 192.168.66.100 will allow other hosts on the Skyus-E LAN to reach the 192.168.1.0/24 network via this second router.

APN

This tab provides the ability to create custom Access Point Name (APN) profiles and set the current profile. The default APN will be assigned by your cellular carrier. The APN defines which networks and IP addressing are assigned by your cellular carrier. Most carriers provide several default APN options for private IP addressing, public IP addressing, public static IP addressing, customer custom IP addressing (private networking / VPNs), and/or restricted static IP addressing. For more information regarding APNs contact your FW representative.

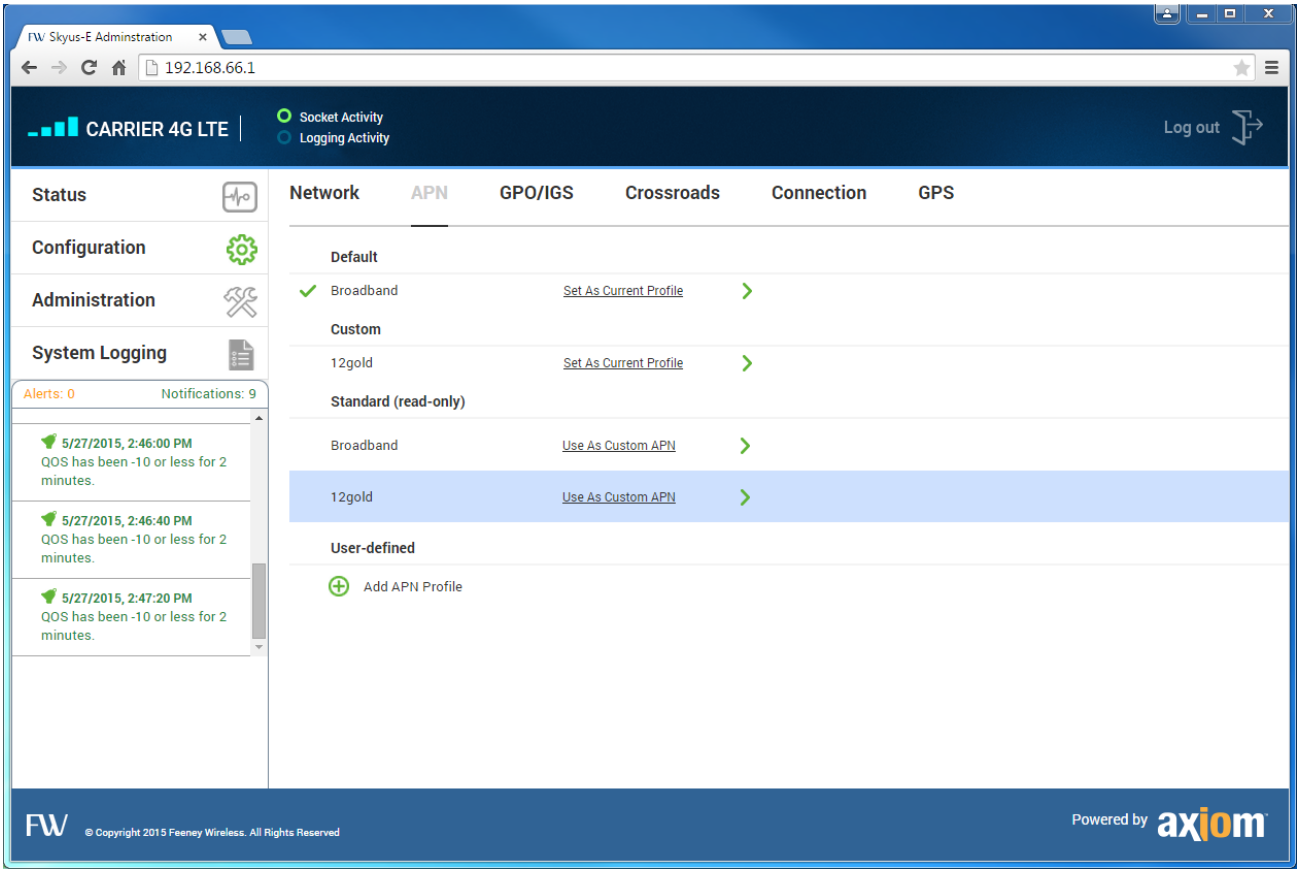

Figure 20: APN Tab

Field	Description
Default	Lists the default APN profile. This is the APN that was assigned to the Skyus during the over the air provisioning process.
Custom	Lists custom APN profiles defined by the user.
Standard (read-only)	Lists standard APN profiles which may be used as custom APN profiles.
User-defined	Lists user-defined APN profiles. For private networking applications this option may be used.

Field	Description
Add APN Profile	Opens a dialog to create an APN profile. • Address • APNName • Authentication • Name (profile name) • PDPType: ipv4, ppp, ipv6, ipv4/ipv6 • Password • PrimaryDNS • SecondaryDNS • UserName
Set As Current Profile	Sets the Skyus-E to the selected profile.
Use As Custom APN	Designates the profile as the Custom APN profile.

GPO/IGS

This tab provides the ability to enable or disable the general purpose output (GPO) and Ignition Sense, and set IGS parameters.

GPO can be used to control an external device. The GPO controls a pin on the Skyus-E power port which can be connected to an external device such as the FW 311 Reset Board to control peripherals.

Ignition Sense is used in vehicle applications. When ignition sense is enabled the Skyus-E will not power up unless a DC voltage between 9V and 36V is applied to the ignition sense pin.

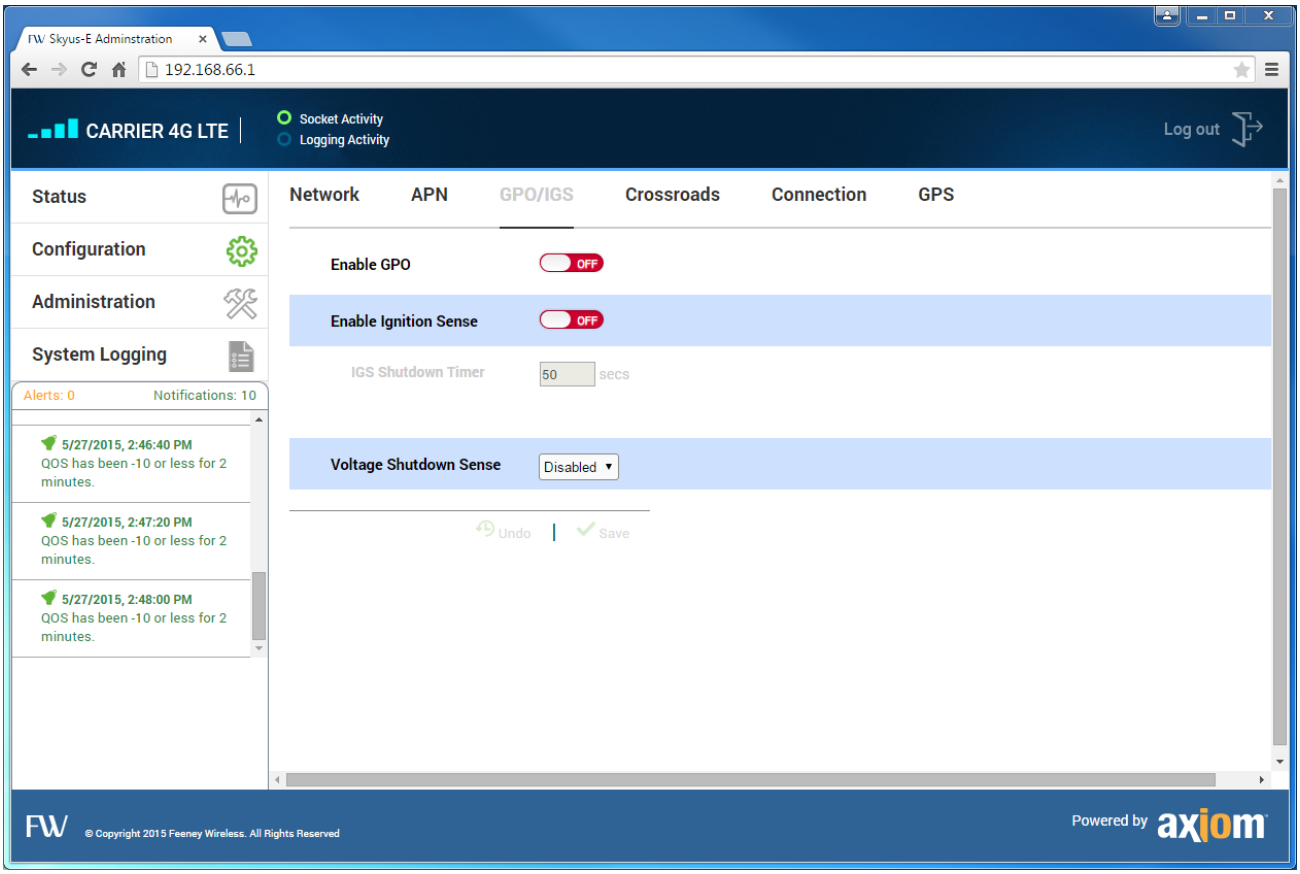

Figure 21: GPO/IGS Tab

Field	Description
GPO	
Enable GPO	Button to enable or disable the general purpose output (GPO). When enabled, the Skyus-E will ground the GPO line. This output is of the open drain type. The GPO is accessed on pin 4 of the Skyus-E power connector (see Figure 6).
Ignition Sense	
Enable Ignition Sense	Button to enable or disable IGS on the power connector for use in vehicle or battery-powered applications.
IGS Shutdown Timer	Sets the shutdown timer. Range: 0-999 seconds. The Shutdown Timer value is the length of time in seconds that the Skyus-E will remain powered up when ignition sense is enabled after the ignition sense pin voltage drops below 9V. This value in most automobile applications is the length of time the Skyus-E will remain on after the vehicle ignition is turned off.
Voltage Shutdown Sense	Sets the IGS mode. Values: • Disabled • Auto – attempts to detect whether the Skyus-E is being used in a vehicle with either a 12V or 24V battery and automatically configure typical low battery thresholds. • Normal – shuts down the Skyus-E when IGS is determined to be outside the designated range after the set shutdown time has passed.

Crossroads

This tab provides the ability to enable connection of the Skyus-E to Crossroads. Crossroads is an Internet of Things (IoT) application framework that can be used to monitor and manage your Skyus-E units in the field remotely. Contact your FW Support for more information or go to the Crossroads Home Page.

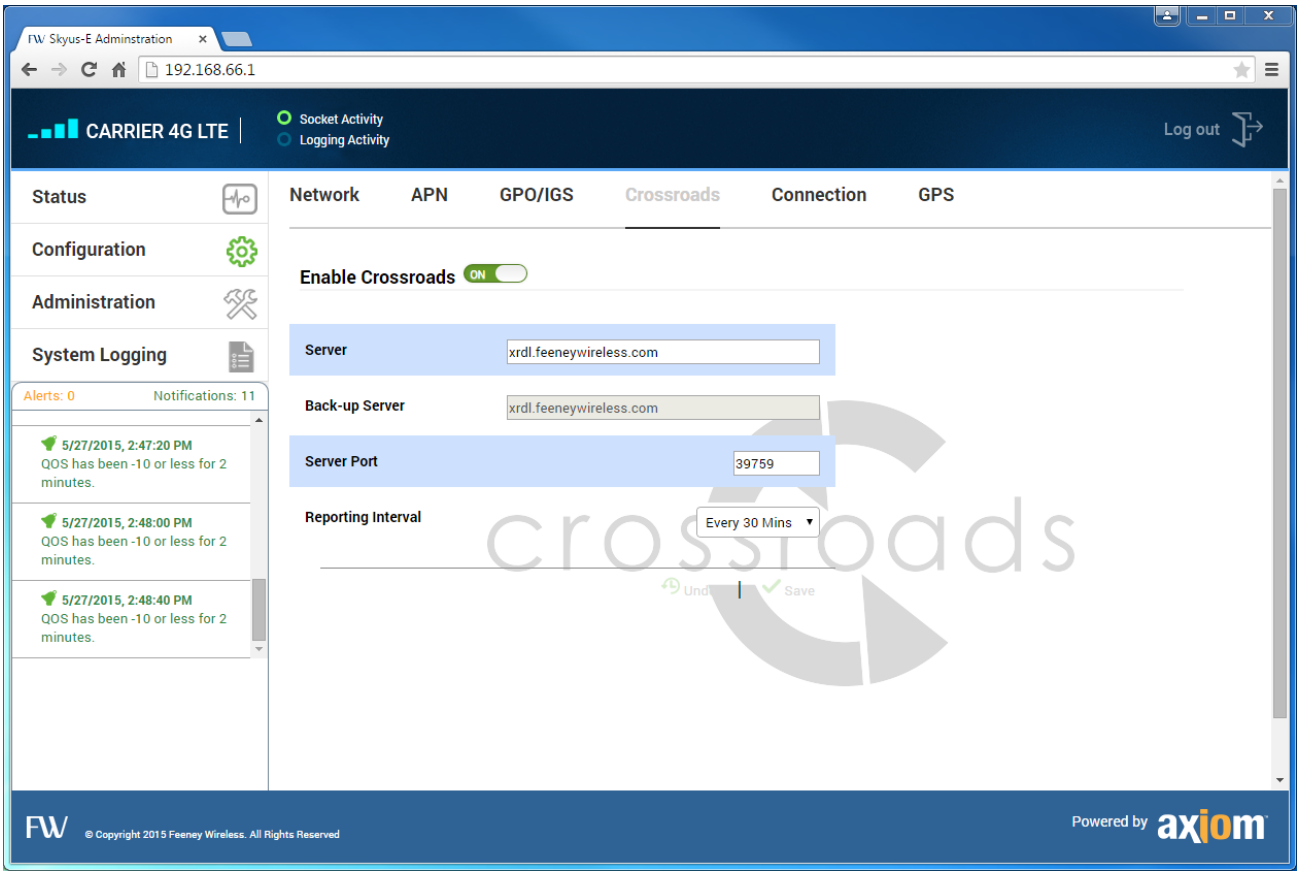

Figure 22: Crossroads Tab

Field	Description
Enable Crossroads	Enables or disables Skyus-E connection to Crossroads.
Server	IP address of the Crossroads server. This only needs to be supplied if the customer accesses Crossroads on a non-FW server.
Back-up Server	IP address of the Crossroads backup server. This only needs to be supplied if Crossroads will be accessed on a non-FW server.
Server Port	Port number of the Crossroads server.
Reporting Interval	Drop-down list to select the time interval for reporting Skyus-E status to Crossroads. Values: Every 5 minutes, Every 15 minutes, Every 30 minutes, Hourly.

Connection

This tab provides the ability to set various connection quality and test parameters.

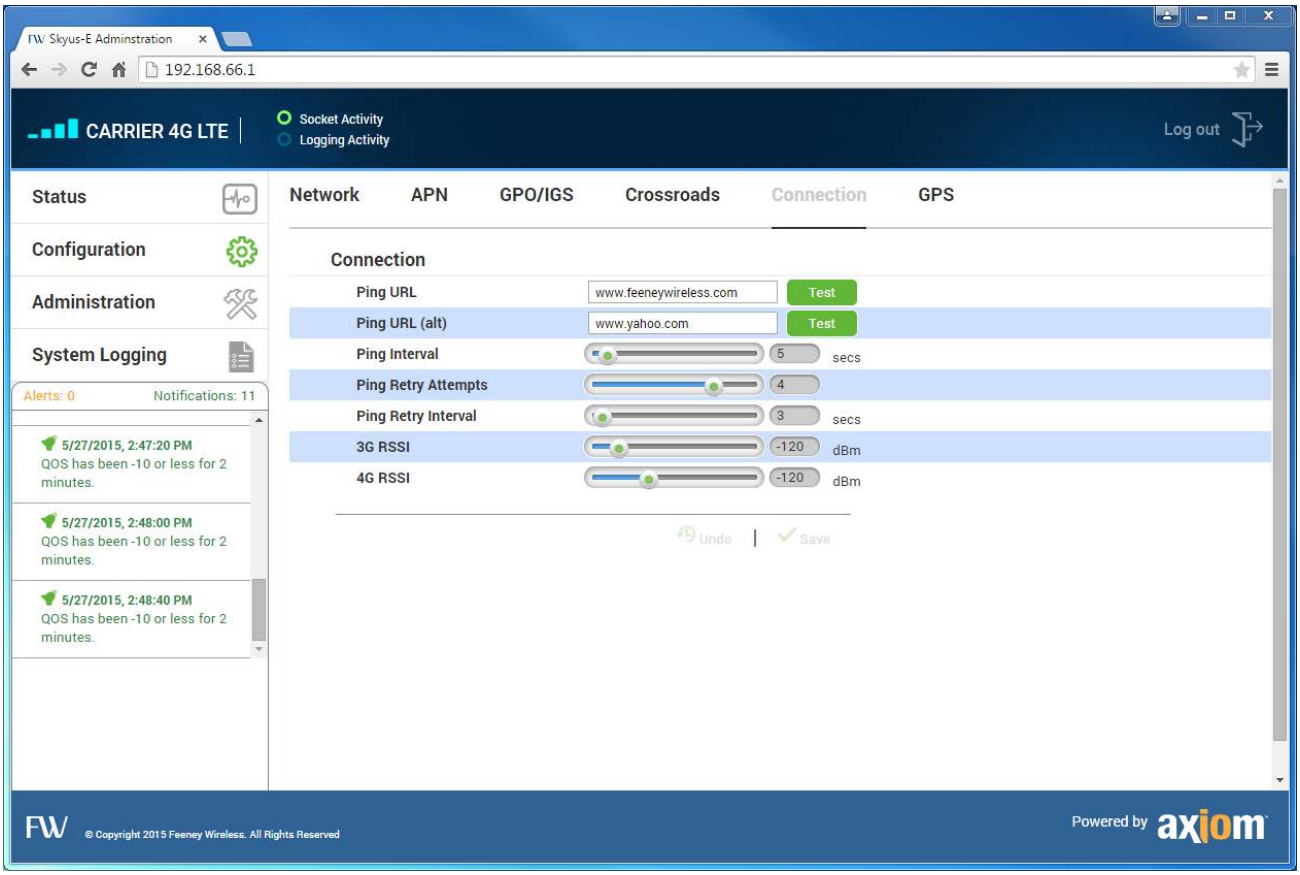

Figure 23: Connection Tab

Field	Description
Ping URL	URL of the primary ping address. The Ping URL and Alt Ping URL values are used by the Skyus-E to test, at the defined Ping Interval, if the Skyus-E remains online and can ping the URLs defined. If the pings fail to both the Ping URL and Alt Ping URL for the number of Ping Retries defined, then the Skyus-E will reset the Skyus modem and attempt to reconnect.
Ping URL (alt)	URL of the alternate ping address.
Ping Interval	Slider to set the interval between pings. Range: 1-60 minutes.
Ping Retry Attempts	Slider to set the number of retries before a reset. Range: 1-5 attempts.
Ping Retry Interval	Slider to set the interval between retries. Range: 1-60 seconds.
3G RSSI	Slider to set the minimum Receive Signal Strength Indicator (RSSI) for 3G connections. Range: -125 dB to -90 dB.
4G RSSI	Slider to set the minimum RSSI for 4G connections. Range: -128 dB to -90 dB.

GPS

This tab provides GPS information and allows you to identify up to four servers to which GPS data is to be sent.

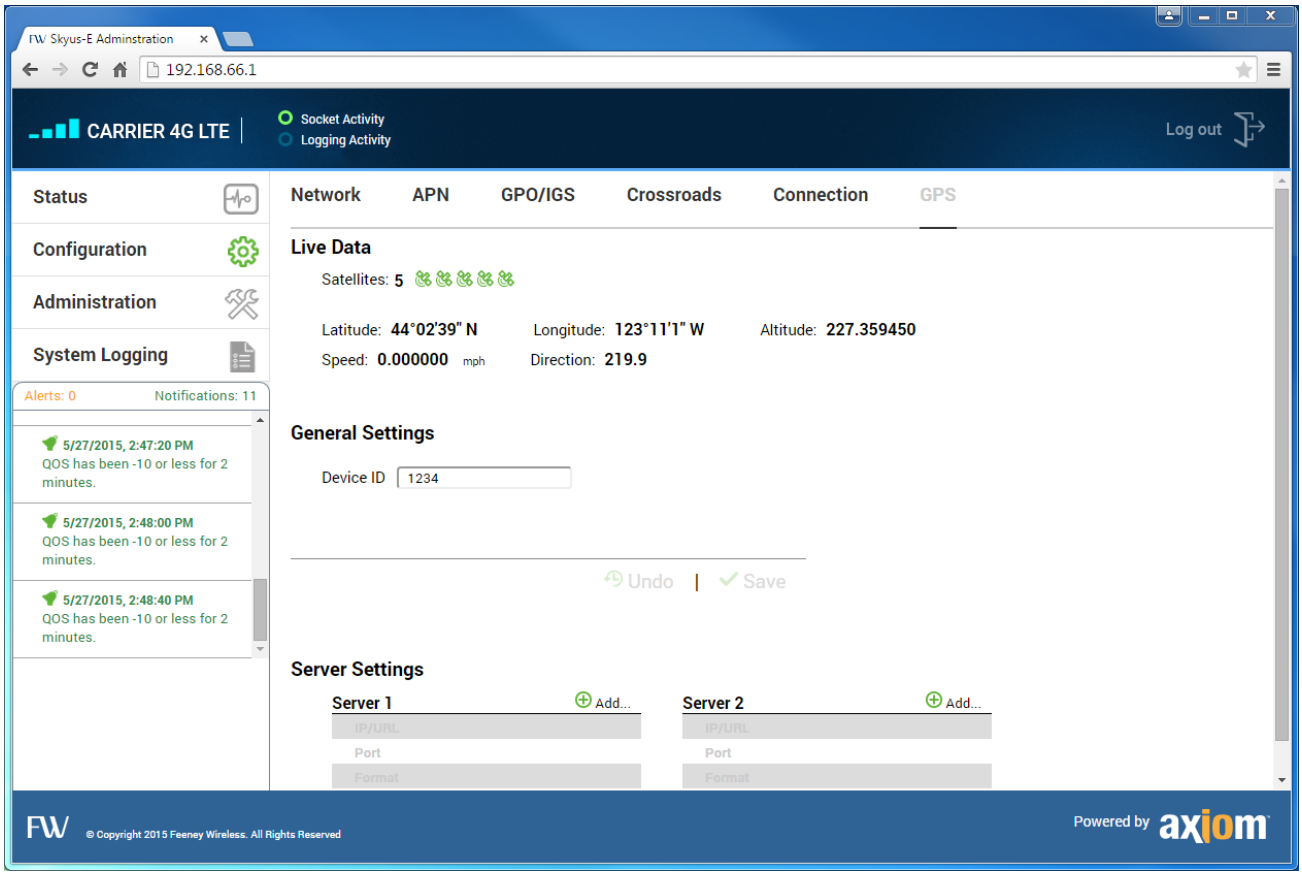

Figure 24: GPS Tab

Field	Description
Live Data	Provides GPS live data, including the number of satellites currently accessed and device latitude, longitude, altitude, speed, and direction.
General Settings	Provides a field for setting the GPS **Device ID**.
Server Settings	Allows you to specify the settings of up to four servers to which GPS data can be transmitted. If no servers are specified, GPS data is sent only to the Crossroads server.

To add a GPS server:

1. Click the **Add** icon (⊕). The **GPS Profile** dialog box opens.

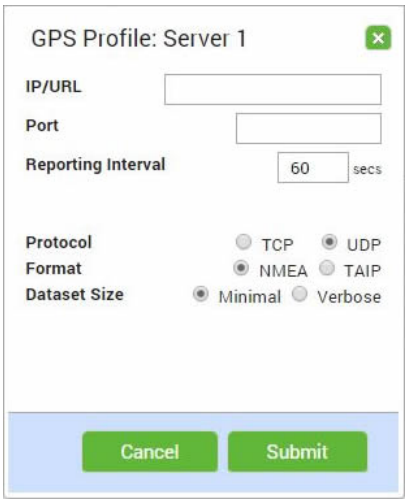

Figure 25: GPS Profile Dialog Box

2. Enter the IP address or URL of the server.
3. Enter the port number.

> **Note:** Each GPS server profile must have a unique **IP/URL** and **Port** combination. If you attempt to enter the same IP and port for a second server, the profile will be rejected. If you wish to use the same server for two profiles, specify a different port.

4. Set the reporting interval. The default is 60 seconds.
5. Set the desired protocol, either TCP or UDP.
6. Select which protocol you want GPS data sent in, NMEA or TAIP.
7. Select whether you want minimal GPS data sent or all data available (**Verbose**).
8. Click **Submit**.

Administration

The Administration page provides the ability to manage users, web client and setting profiles, view firmware information and upload firmware files, and view and set limits on data usage. To access this page, click Administration in the navigation panel. Information is organized under three tabs: User, Settings, and Firmware.

User

This tab provides information on network users and provides the ability to add new users and set their access levels.

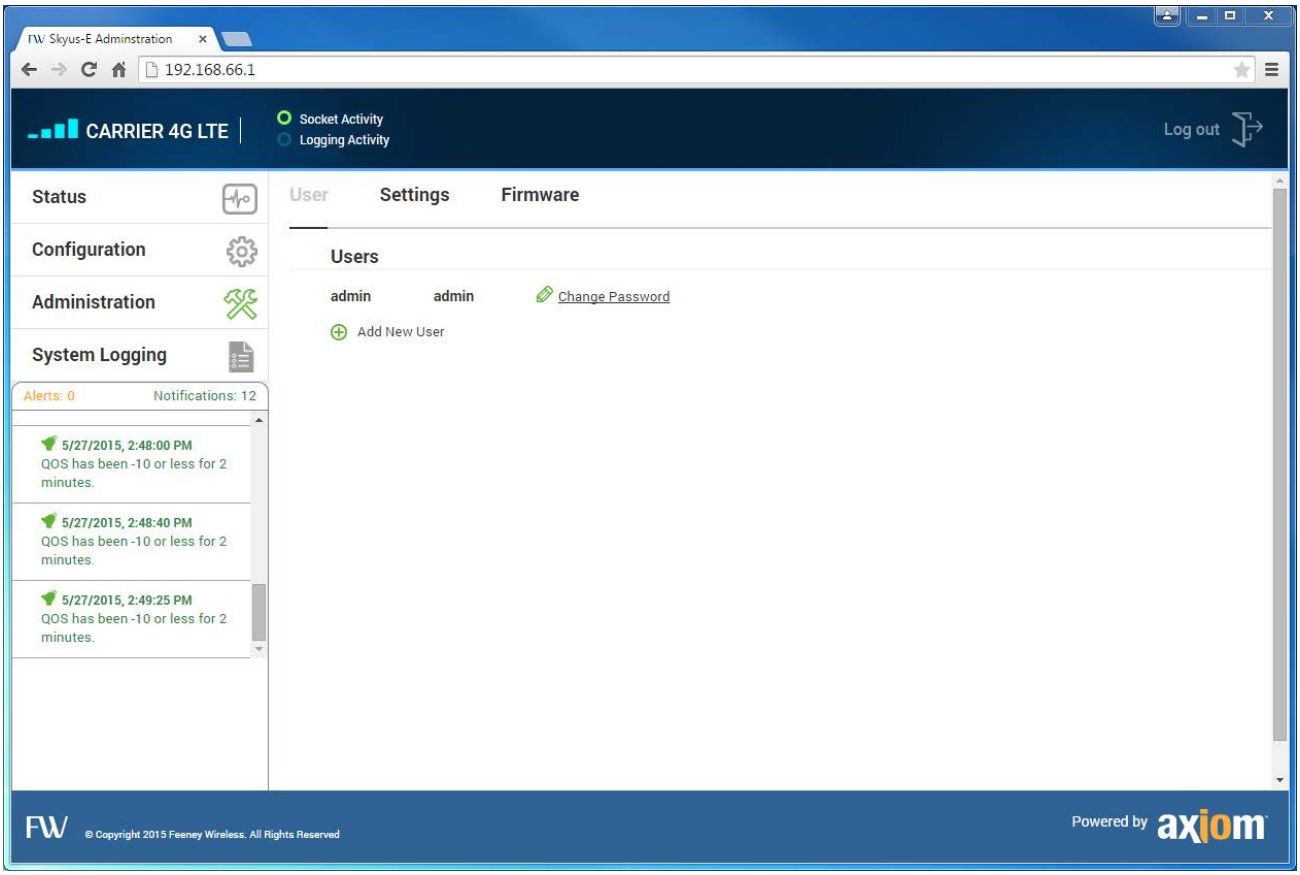

Figure 26: User Tab

Field	Description
Change Password	Opens a dialog to change a user's password. • Old Password: Enter the user's old password. • New Password: Enter the new password. Passwords must be at least eight characters. For security reasons, it is a good idea to change the admin password. Keep a record of the new password in a secure location.
Add New User	Opens a dialog to add a new user. • Username • Password • Level: User, Admin. Admins can change Skyus-E settings. For users, settings are read-only. All users should keep a record of their passwords in a secure location.

Settings

This tab provides the ability to set the local and remote port number for access to the Skyus-E Utility, and create and manage setting profiles.

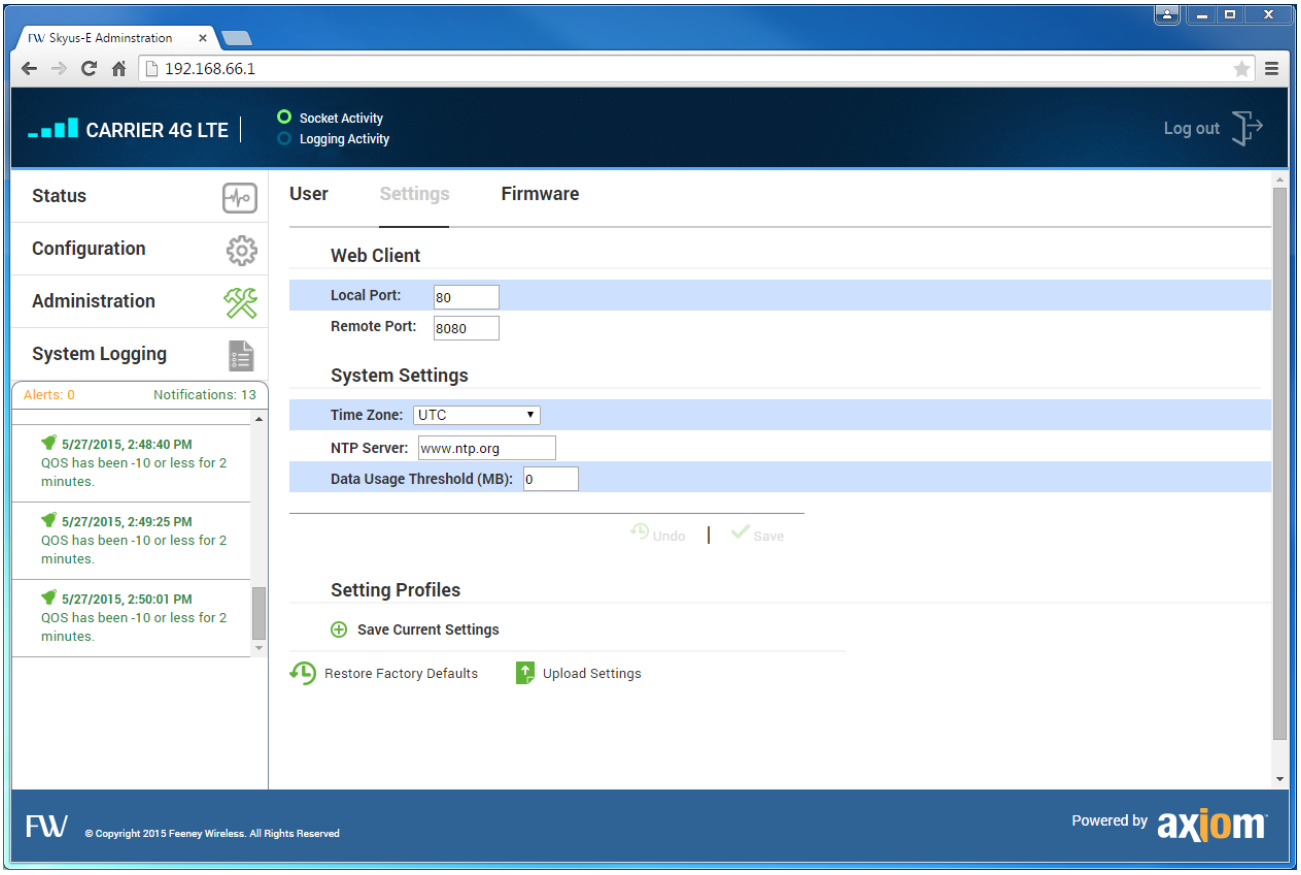

Figure 27: Settings Tab

Field	Description
Web Client	
Local Port	TCP port to access the Skyus-E Utility from the LAN. Default: 80.
Remote Port	TCP port to access the Skyus-E Utility from the WAN. Default: 8080.
System Settings	
Time Zone	Selects either UTC (Universal Coordinated Time) or a local time zone.
NTP Server	Enter the URL of the Network Time Protocol (NTP) server you want the Skyus-E to use and click Apply. By default the Skyus-E will obtain the current UTC time from the cellular network upon connecting.
Data Usage Threshold (MB)	Allows you to enter the upper threshold of your monthly data plan. The system will use this information to indicate what percentage of your data plan has been used by changing the color of the **Activity** LED (see "Activity LED").

Field	Description
Setting Profiles	
Set Current	Sets the selected profile as the current profile to revert to in the event of a reset to user defaults via either the web interface or reset button.
Update	Applies the current Skyus-E settings to the selected profile.
Export	Exports the current profile.
Delete	Deletes a profile.
Save Current Settings	Creates a new profile based on the current Skyus-E settings.
Restore Factory Defaults	Restores the Skyus-E to factory settings. You will be prompted to confirm the restore.
Upload Settings	Opens a dialog to select a settings file to upload. The dialog allows you to name the profile and browse to the file to upload.

Firmware

This tab displays the current software and firmware versions installed on the Skyus-E and provides the ability to upload Skyus-E firmware upgrades.

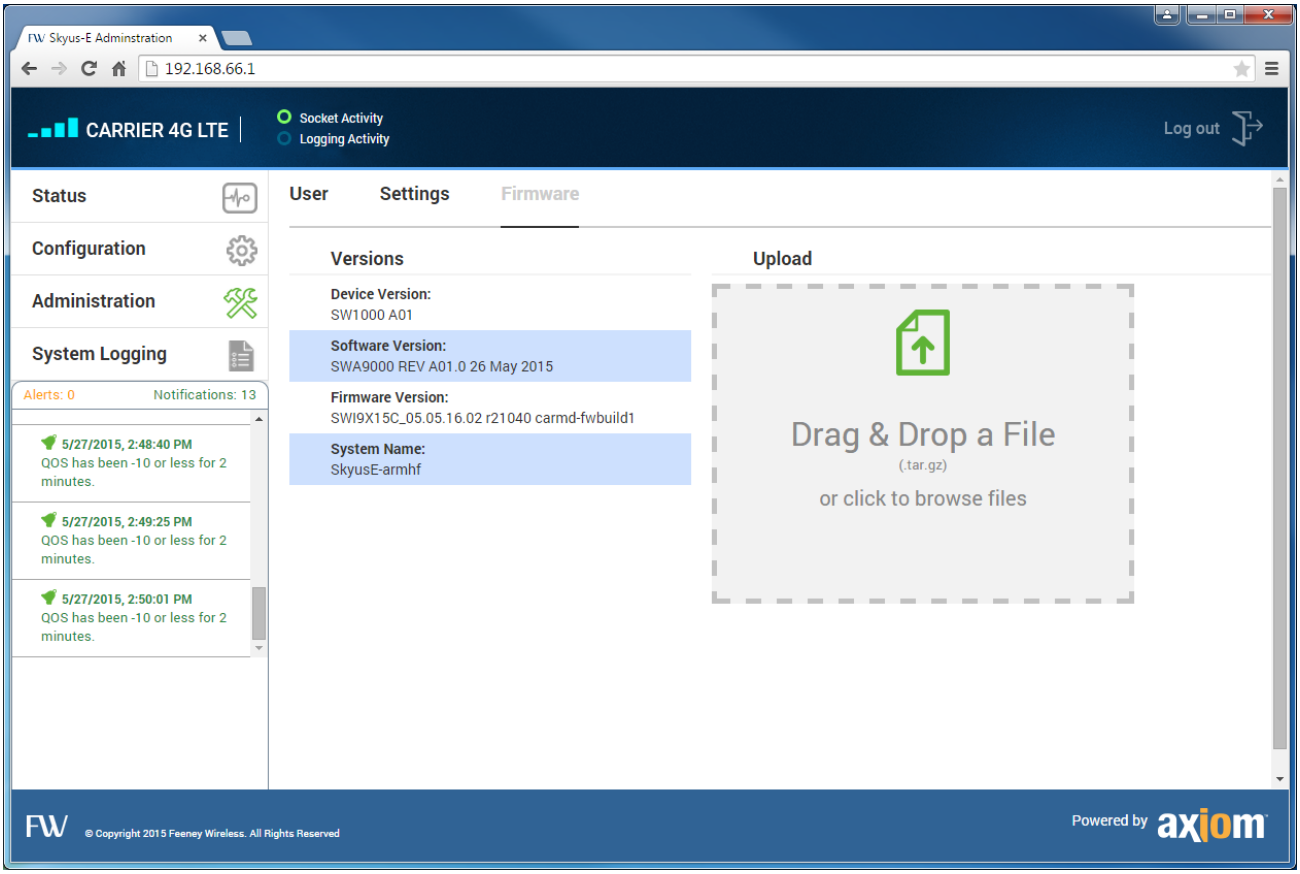

Figure 28: Firmware Tab

Field	Description
Versions	
Device Version	Skyus-E firmware version.
Software Version	Skyus-E processing module firmware version.
Firmware Version	Skyus module firmware version.
System Name	Host name.
Upload	
Upload Area	Drag and drop a .tar.gz file or click the upload area to browse to a file. This will update the Skyus-E firmware. Firmware upgrade files are available from FW Support.

System Logging

The Skyus-E provides extensive system logging capabilities.

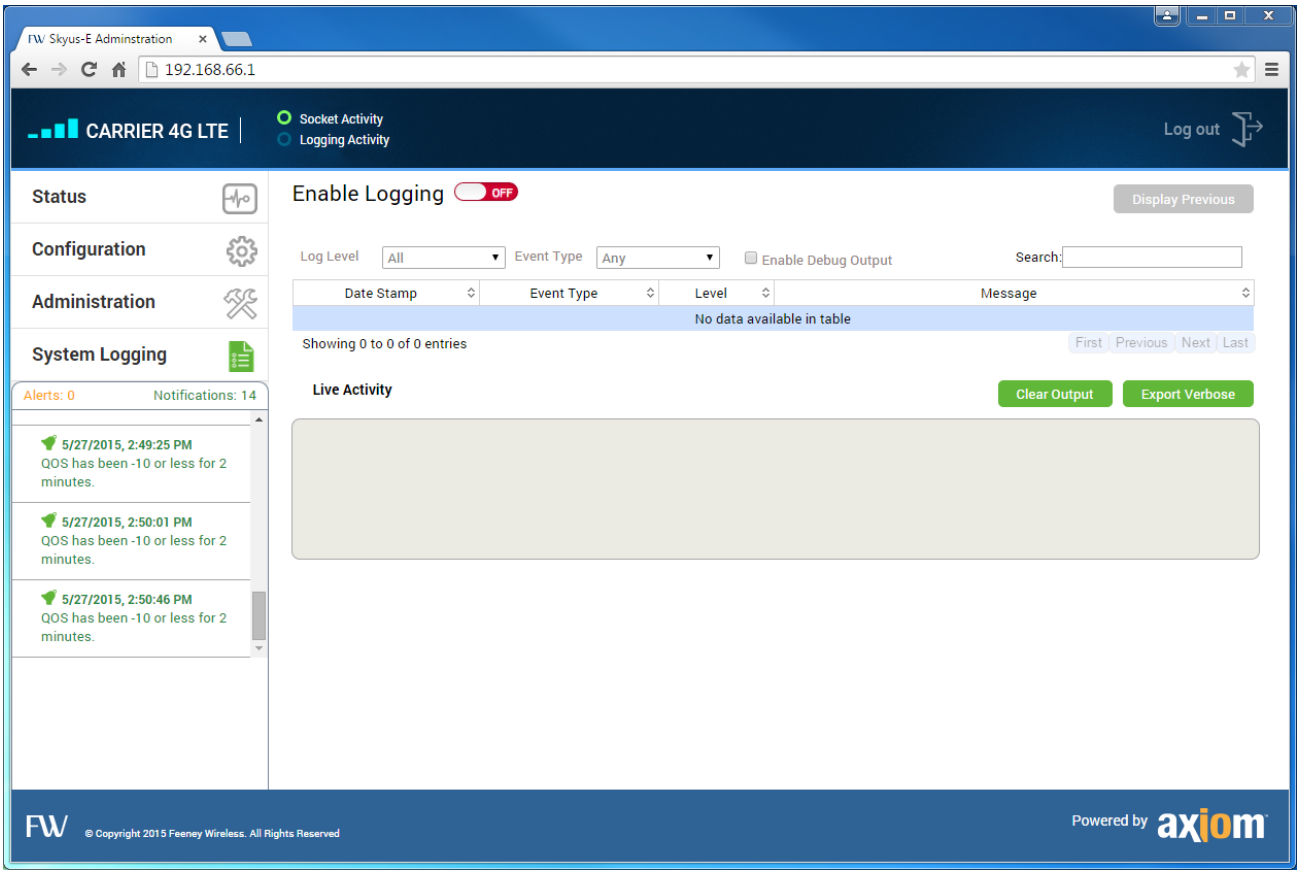

Figure 29: System Logging

Field	Description
Enable Logging	Click the button to turn logging on or off.
Log Level	Select the log level: All, Info, Warning, Critical, Debug.

Field	Description
Event Type	Select the event type: Any, Cellular, System, Hardware.
Enable Debug Output	Checkbox to enable or disable debug output.
Search	Search on any word found in a log. You can search for multiple words by putting a space character between them.
Log Table	Log results sortable by TimeStamp, Event Type, Level, or Message.
Live Activity	Displays the unsorted most recent log messages.

Contacting FW

For help with installing, operating, maintaining, and troubleshooting this product, refer to this document and any other documentation provided. The troubleshooting tips provided in Appendix A should be followed before contacting support at FW. If you still have questions, contact us during business hours: Monday through Friday, excluding holidays, between 8 a.m. and 5 p.m. Pacific Time.

Contact Us	
Support E-Mail	support@feeneywireless.com
Telephone	(800) 683-4818
Website	www.feeneywireless.com
Mailing Address	P.O. Box 2549, Eugene, OR 97402

When contacting technical support, please have the following information on-hand:

- Serial number on product label
- Date that you received your device
- A brief description of the problem

Online Library

For other documentation, see our online document library at:

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FCC Compliance

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communication. FW does not guarantee that interference will not occur in a particular installation.

Operation is subject to the following conditions:

a. This device may not cause harmful interference.
b. This device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

If this equipment does cause harmful interference to radio or television reception, which can be determined by tuning the equipment off and on, the user is encouraged to try and correct the interference by one or more of the following measures:

a. Reorient or relocate the receiving antenna.
b. Increase the distance between the equipment and the receiver.
c. Connect the equipment to outlet on a circuit different from that to which the receiver is connected.
d. Consult the dealer or an experienced radio/TV technician for help.

Exposure to RF radiation - To comply with FCC RF exposure compliance requirements, for mobile configurations, a separation distance of at least 20 cm must be maintained between the antenna of this device and all persons. Do not collocate or operate this device in conjunction with any other antenna or transmitter.

The TX module FCC ID depends on the Skyus module installed. See the Skyus Specification Sheet or the Skyus DS Specification Sheet.

Appendix A: Troubleshooting

The majority of faults result from insufficient power or incorrect configuration. Power supply and configuration should be the first things checked before more extensive troubleshooting begins. Make sure the Skyus-E and the internal Skyus module are properly installed according to the instructions in this manual or the Quick Start Guide before searching for other remedies.

One of the first things to establish is whether the device was working prior to the fault without any change to the hardware or software settings. If the unit was working initially, investigate power quality first. Also, look for signs of physical damage or tampering.

In many cases when a fault is detected, it is still possible to log in to the Skyus-E Interface. Doing so will provide you with additional information about the unit that will help you to determine a remedy.

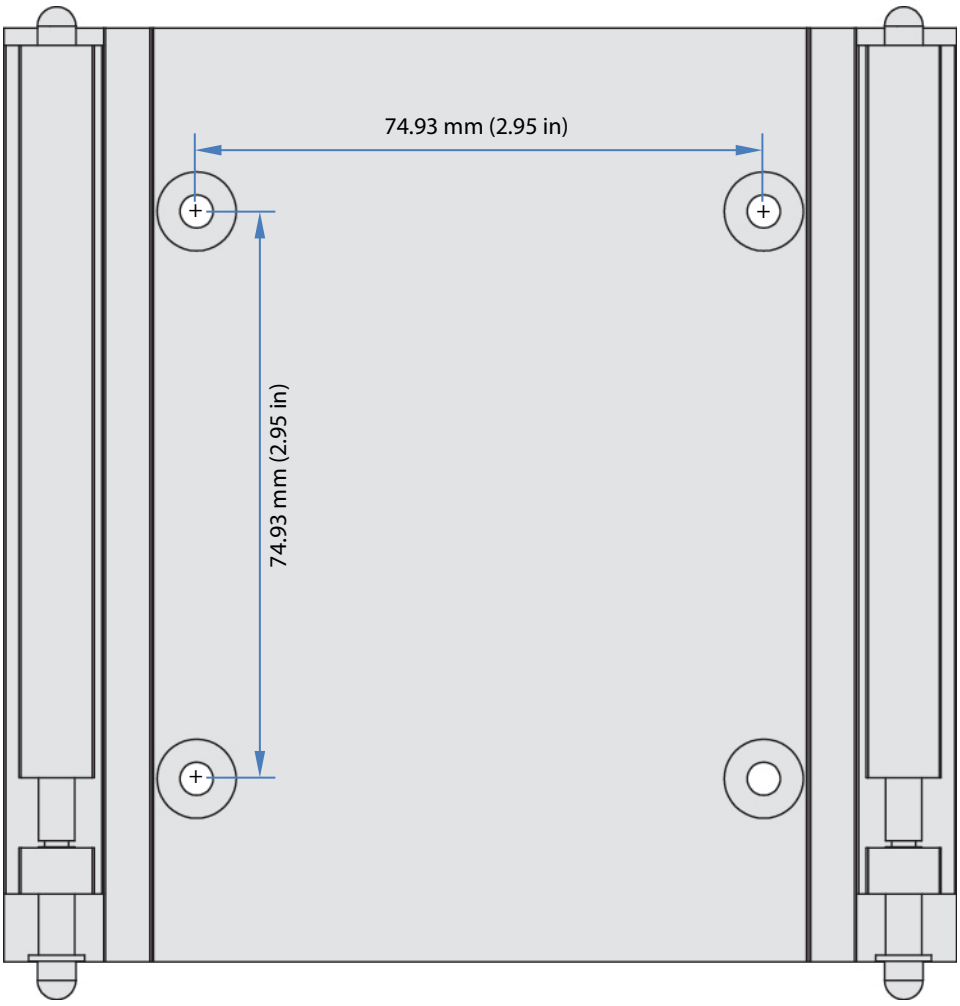
Fault	Remedy
Power LED is not lit. No other LEDs are lit. Cannot connect to the Skyus-E.	Check the power source and connections.
Power LED is flashing red.	This indicates an over or under voltage condition, or an over or under temperature condition. Remove power from the device and allow the unit to cool if the Skyus Temperature value was high or the unit is being operated in hot ambient conditions. Reapply power.
Power LED is solid red.	This indicates a non-recoverable unhealthy state. Contact FW customer support.
Power LED is flashing quickly, and one or more of the following is true: • At least two minutes have passed since power was applied to the Skyus-E (allowing time for the cellular connection to be made) • No other LEDs are lit • "No Modem Detected" is displayed in the interface banner • Connection State = Down • Connection Type = None • QoS = no value • Alert: "Connect was dropped or lost"	These symptoms all point to a problem with the Skyus module inside the Skyus-E. Open the front panel of the Skyus-E as shown in "Appendix C: Swapping Modems." If no Skyus module is installed, install a module. If a Skyus module is installed, make sure the USB and antenna connectors are correctly and firmly attached. If the connections are good, try swapping out the Skyus module with a known working device. If a connection can be made with a different Skyus module, the SIM card inside the original may be missing, installed incorrectly, or damaged. Contact FW customer support.

Fault	Remedy
Signal strength drops to no bars. Other symptoms might include: • Connection Type degrades (for example, to 2G) • Signal Strength drops to a large negative value (for example, -128 dBm)	Check antenna connections. If using only one antenna, make sure it is connected to the SMA connector labeled "Primary."
Antenna(s) are connected, but signal strength is still low.	Check the internal antenna connections to the Skyus modem. Open the front panel of the Skyus-E as shown in "Appendix C: Swapping Modems." Make sure both internal SMA antenna cables are connected to the Skyus. The shorter cable labeled FW8163-A is the Primary antenna cable and should be attached to the outermost antenna connector on the Skyus module. The longer cable labeled FW7837-A is the Secondary antenna cable and should be attached to the innermost antenna connector on the Skyus module.
After selecting an APN profile other than the Default on the Configuration > APN screen: • Cellular connection is lost • The Power LED flashes green • The Skyus-E Interface becomes inaccessible	This occurs when an invalid APN profile has been selected as the current APN profile. Press and hold down the reset button until the Skyus-E resets, approximately five seconds. The Signal Strength LEDs will flash green when the reset occurs. Access the Skyus-E Interface. (You might have to refresh the browser if the log-in screen still shows that the interface has timed out.) On the Configuration > APN screen, set the current APN profile to the Default. The Skyus-E will reset using the default APN profile. This will take up to two minutes.
After selecting Enable Ignition Sense on the Configuration > GPO/IGS screen and clicking Save: • Cellular connection is lost • The Power LED goes to solid green	If the ignition sense line (pin 3 on the power connector) has not been properly implemented and IGS is enabled, the Skyus-E will shut down after the shutdown period. Remove and reapply power to the Skyus-E. Log in to the Skyus-E Interface as soon as possible, disable IGS on the Configuration > GPO/IGS screen, and click Save.

Appendix B: Mounting Plate Template

Printed at full-size, the illustration below can be used to mark the center points of the four screw holes for installing the mounting plate. After printing the template, measure the distance between the holes to make sure the size is accurate, as shown below.

NOTE: Some print drivers will provide the option to "fit to printer margins" which may cause scaling. To ensure that the size is accurate, make sure to print to actual size.



Appendix C: Swapping Modems

The following instructions describe the procedure for swapping modems in the Skyus-E enclosure. For instructions on installing a Skyus modem into the Skyus-E Retrofit kit, see the Skyus-E Retrofit Assembly Instructions.

The figure below shows how to access inside of the Skyus-E in order to swap a Skyus radio module.

1. Faceplate Screws x4
2. Faceplate
3. Skyus Radio Module
4. Pull Tab
5. Antenna Cable Clip
6. USB
7. Secondary Antenna
8. Primary Antenna
9. Skyus-E Enclosure
10. Mounting Plate

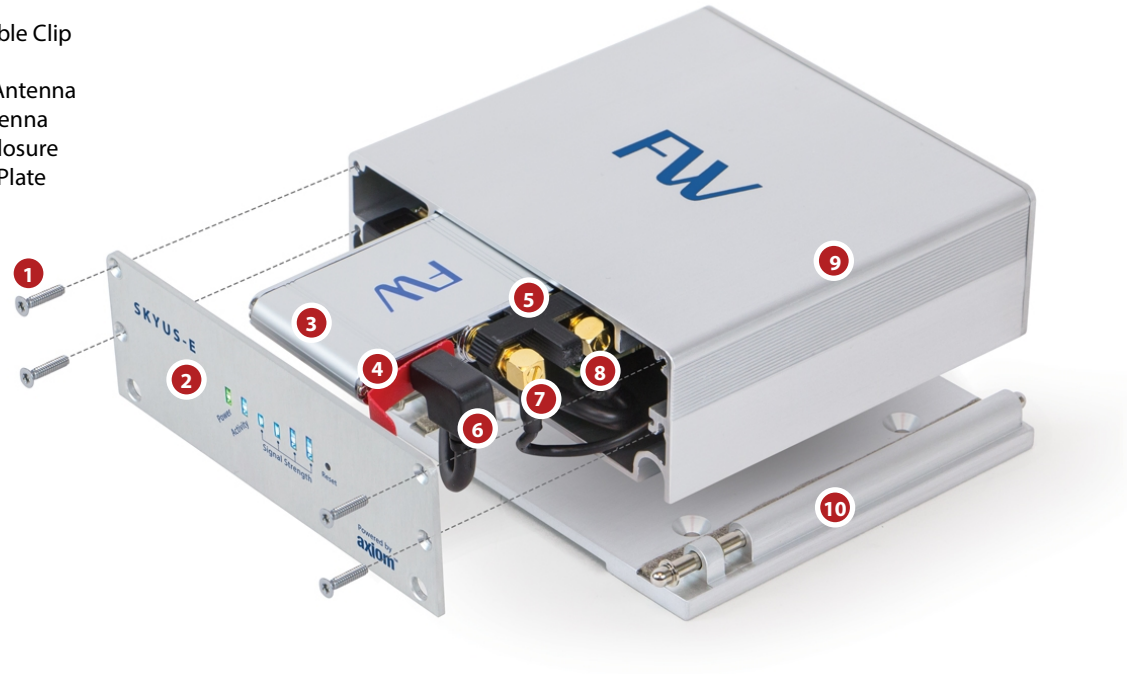


Figure 30: Skyus Modem Installation (Single SIM Modem)

1. Detach the Skyus-E from the mounting plate (10) if it is attached.
2. Access the inside of the Skyus-E by removing the four screws (1) securing the faceplate (2) using a T8 Torx driver.
3. Pull out the existing Skyus modem (3) using the red pull tab (4).
4. Remove the antenna cable clip (5).
5. Disconnect the USB (6), secondary antenna (7), and primary (8) antenna cables from the existing modem and attach them in the same order to the new modem. When plugging in the USB cable, make sure to position the pull tab over the connector for easy modem removal in the future. SMA connectors should be tightened to 8 in-lbs. using a torque wrench with a 5/16 bit.

   Note: The cable labeled **FW8163-A** is the **Primary** antenna cable and attaches to the outermost antenna connector on the Skyus module. The cable labeled **FW7837-A** is the **Secondary** antenna cable and attaches to the innermost antenna connector on the Skyus module.

6. For GPS models, connect the GPS cable to the middle SMA connector (*not shown*).
7. Snap the cable clip (5) into place over the antenna connectors.

8. Slide the Skyus module into the modem compartment, carefully tucking in the cables so that they do not extend beyond the opening of the Skyus-E enclosure and do not catch on the front edge of the PCB. The Skyus fits snugly in the compartment, so be sure to apply firm pressure.
9. Replace the faceplate.

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zlib General Purpose Compression Library Version 1.2.8 License

zlib.h -- interface of the 'zlib' general purpose compression library version 1.2.8, April 28th, 2013

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WebSocket++ Version 0.5.1

WebSocket++ is an open source (BSD license) header only C++ library that implements RFC6455 The WebSocket Protocol. It allows integrating WebSocket client and server functionality into C++ programs. It uses interchangeable network transport modules including one based on C++ iostreams and one based on Boost Asio.

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